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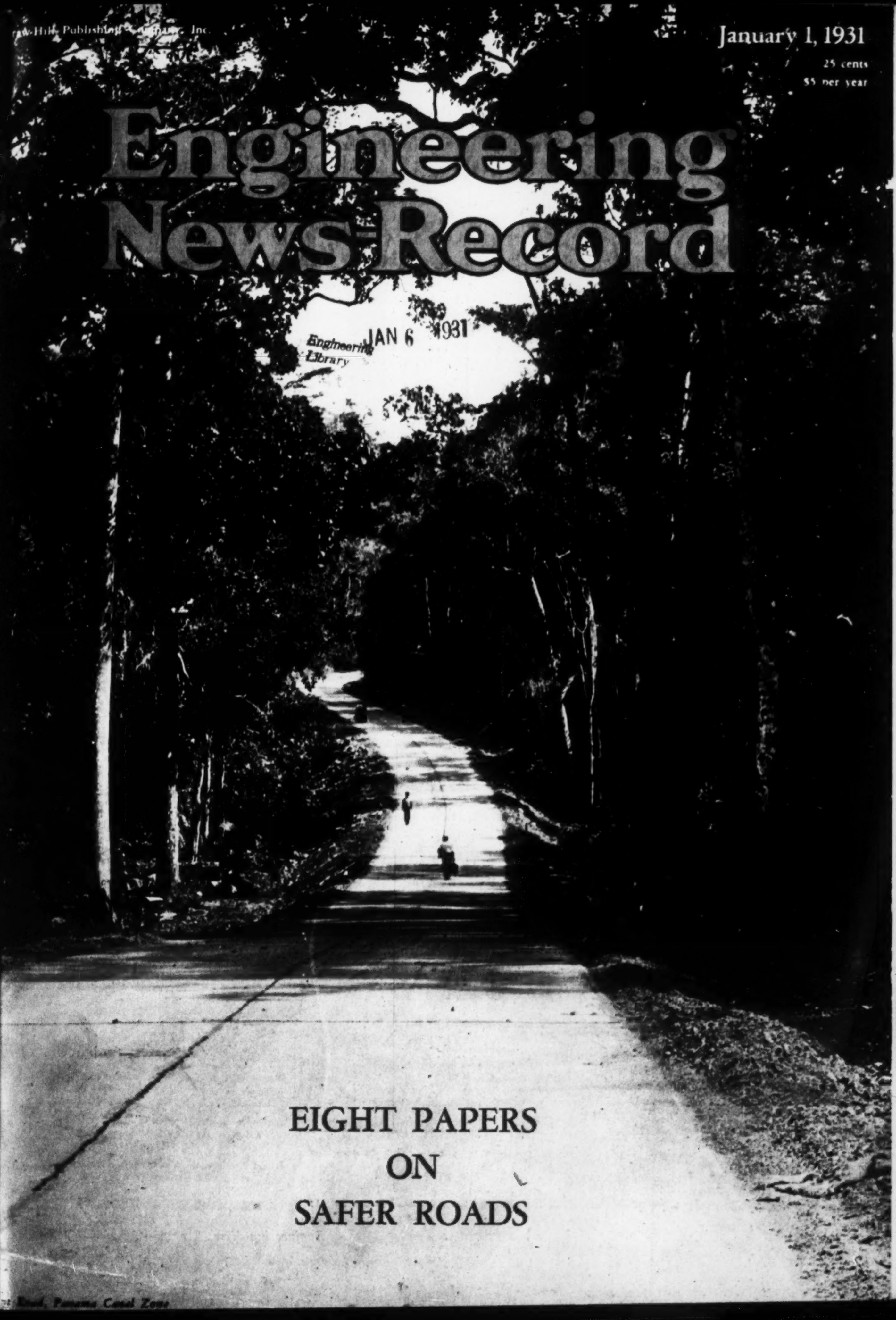

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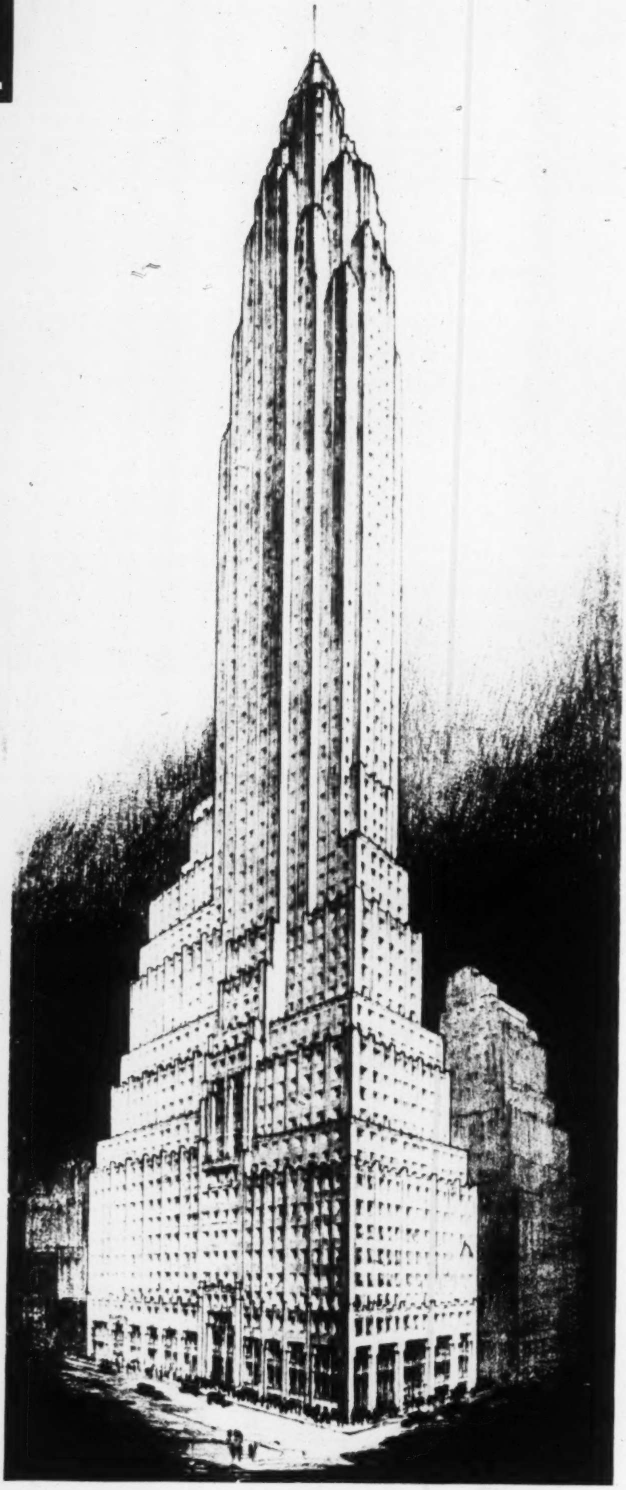

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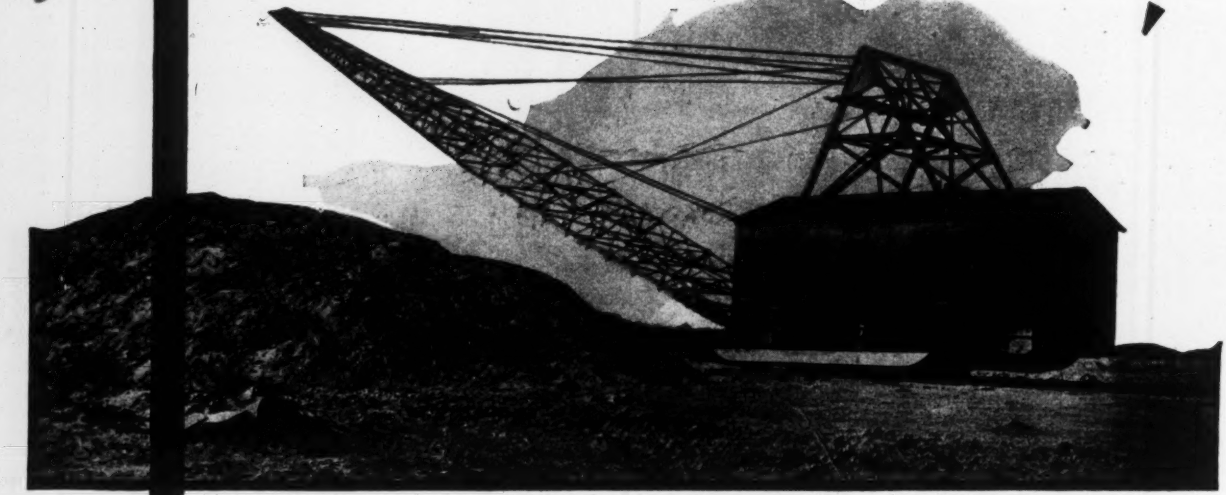

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. Schmitt, *Editor*

Volume 106 NEW YORK, JANUARY 1, 1931 Number 1

THIS ISSUE—SAFE ROADS

AT A TIME when the most intensive efforts are being applied to the task of doing more road construction in order that unemployment may be reduced, there is no need to emphasize further the commanding position of the road builder's art among current human activities. So large a part of the engineering profession is concerned with highway problems that we dedicate to their interests this, the opening issue of the year, as we have done for some years past. The purpose of the issue is to center thought on the outstanding questions which control the further evolution of road building.

The art has reached a high pitch of perfection. Modern roads are a wonderfully efficient tool of transportation. But not all their problems have been solved; on the contrary, each year a greater number demands solution. Planning, structural design, field construction, and operation and maintenance, all are replete with new problems, and no one may say that any single one among them is weightier than another.

Yet one disturbing fact speaks more and more insistently out of the daily reports of happenings the country over. Death and injury on the highway increase continually, instead of becoming less, as should be the case by virtue of better skill and knowledge. Can safer roads be built? Are road hazards being studied carefully enough?

THOUGHTS that spring out of these questions are set forth in this issue by a number of aggressive and original thinkers in the highway field. We have selected and grouped these articles in the effort to stimulate and guide the thinking of engineers on their share of responsibility for road safety. The long miles of road built each year should be made better roads—better in being able to carry their traffic more safely, to the end that the dark record of accident may be improved.

The Engineer's Part in Eliminating Road Hazards

STATISTICS confront us with the startling fact that more than thirty thousand lives are sacrificed each year on the roads of the United States by motor-vehicle accidents. We know that most of them are avoidable, and it is therefore our imperative obligation to reduce the huge, growing accident toll. What part has the highway engineer in this work?

When road improvement was begun the only thought was to build better roads—smooth, hard-surfaced roads able to convey traffic in all weathers and seasons. Our ideals did not go beyond this point. We assumed that so long as a hard and reasonably smooth road was provided, the road user could be relied on to do the rest; the road could be traveled safely, and it was therefore his obligation to travel in safety. Those primitive ideas have been outlived.

IN THE same early days, we may recall, speed limits were fixed by fiat, and everyone who moved faster than twenty-five or perhaps thirty miles per hour became a criminal. The very existence of the improved road overthrew these narrow conceptions, and even brought us to the point of learning that slow travel may be more dangerous than fast travel. In that general advance, in the process of learning new facts and perceiving new conditions, we also acquired a new understanding of road safety. We found that the highway engineer is a direct factor in safety questions.

He is involved in design and construction, so that the highway roadbed may be inherently safe; in the provision of those accessories which are essential to safe operation, as signals, information signs, lane marks and shoulders; in the treatment of special problems that arise at branches, intersections and other danger points; and finally in safe maintenance of the road. In none of these matters have we progressed far enough to meet the day's need. Much has been done, but much more remains to be done.

DESIGN has seen the greatest advance among the factors just mentioned. The paved road of today is a highly developed structure compared with what was considered first-class road in the early years of the century. Quite aside from excellence of surface, the improvements made in alignment, width, uniformity and cross-profile compare well with the best achievements of railroad engineering. Visibility also has been given careful thought; this was one of the early lessons in highway safety. But with all these advances, much remains to be learned in respect to safe design and construction of roads. Continuous study of operating conditions and experiences is essential to define the hazards which still exist. This is the engineer's task.

It is true that partial responsibility for safer highway engineering rests upon others than engineers themselves. Except in detail, their planning is often restricted by considerations imposed from without. Rarely is the highway engineer permitted to build the safest road. The public still demands mileage. When the physical hazards of highways are better recognized, highway engineering will have freer opportunity to deal with them. In the meantime, working under this handicap of restriction, the engineer carries the obligation of perfecting design safety to the utmost.

For some years much stress has been laid on the personal factor in highway accidents. There are many who believe that accidents result largely from unfitness of vehicle or driver or from negligence. Such beliefs stand in the way of adequate valuation of the physical hazard. Highway engineers will do better to take an opposite view, and look upon all highway accidents as caused by road factors, which it is their duty to eliminate. The accident-proof road may be a mere vision, but this vision should animate highway engineering endeavor.

IF CONTINUED study of design is essential, study of road accessories or operating equipment is quite as urgent. Progress here has also gone far, but with disappointing unevenness. Some roads have elaborate equipment, others are bare of all safety accessories. Even the most complete equipment sometimes appears to promote rather than prevent accident.

Uniformity is the most urgent need in this field. Praise is due those who have labored to devise the best forms and locations of signs, signals and markings and bring about the adoption of uniform standards. But if even the simplest elements are still unsettled, if we still fail to agree on proper use of the red light, on relation of turns to stop signals, and on methods of signaling from vehicles, it is clear that intensive work must continue.

Large contributions to operating safety have been made by vehicle builders. Brake improvement is a case in point. Others, as the headlamp, remain serious problems. But the highway engineer is quite as backward as the vehicle builder in respect to making night travel safe. Quite generally, the safety equipment of the road involves as joint factors the vehicle, the operator, the road and its equipment. And of these the operator is the final limiting element. When signs and signals reach such complication and unintelligibility or inaccessibility that they become an impossible burden to the driver, they create hazards instead of eliminating them.

A RELATIVELY newer problem than the hazards of the open road lies in special or localized hazards, especially those of intersections. The perfect solution of intersection and branch problems still appears to be beyond reach. A great amount of ingenuity and expenditure has been lavished upon them, with only indifferent success. Opinions often diverge diametrically. The traffic circle, to some an ideal, is anathema to others. Intersection problems are growing in importance more rapidly than any other single feature of the highway art. They will undoubtedly claim more systematic study in future than has yet been given them.

What maintenance means to safety is steadily coming into clearer light. There was a time when maintenance itself received little thought save as a necessary evil on roads of low degree, and it was unthinkingly believed that a first-class road when once built would always continue to be safe. Best present-day highway practice looks upon maintenance as fully coordinate with construction, in its bearing on transportation efficiency; and quite the same view applies to safety. It is becoming well understood that a road left to itself will become less safe, while if well maintained it will gain in safety.

Safe maintenance is, in short, the necessary follow-up on safe design and construction. The engineer of maintenance must not merely maintain but steadily improve shoulders, ditches and turns, must provide sidings or roadside stopping places, not often included in construction plans; must deal with temporary hazards of many kinds, including that interesting variety which results from flooding of low stretches of road; must deal with snowfalls and settlement, and above all with deterioration, which in all forms creates erratic hazards.

Maintenance today remains one of the least thoroughly developed phases of highway administration and therefore is certain to grow very largely in importance. In this growth its intimate relation to the elimination of road hazards will come to receive universal recognition. The future evolution of design for safety and the rise of safety maintenance are developments which promise to affect profoundly the range of thought and the work of all elements of the highway engineering profession.

One More Warning

REFRESHING frankness in urging a diversion of gasoline-tax and motor-vehicle license money from highway uses is exhibited by Milton H. Welling, secretary of state of Utah. According to press dispatches from the Mormon capital the secretary finds that the highway department is getting more and more money yearly from motor-vehicle taxes while the state's general fund "is embarrassed a good bit of the time." Therefore he feels that it is only fair that some of the gasoline taxes and license fees should go into the general fund.

It is likely that most of the diversions of past years and all those that will be sought this winter in the 42 state legislatures which will be in session are based on the same motive as that urged by Secretary Welling, although the thought has seldom been so ingenuously expressed. Claiming a portion of the tolls which automobilists pay for highway service to assist in building schools, waterways and state institutions because they need the money will during the next few months be highly popular, unless all signs fail, among all taxing agencies. If state legislatures are to hold firmly against the demand, highway officials and the road-building industries as well as road users will have to inject liberal doses of starch into legislative backbones. The task, moreover, will not be accomplished by resolutions passed at conventions or exhortation in association bulletins; it must be attacked by direct representation in the legislative halls where the interests that advocate diversion will be present in person to push their campaigns.

The current year is likely to be a critical one in respect to gas-tax diversion. Since the first beginnings of diversion, only a few years ago, the appetite of the many special interests that look on the gas tax as a convenient subject for pillage has been sharpened by the frosty air of the business depression; the effortless collection of funds from road users has become every day more alluring to them. At the same time realty interests have sounded a growing chorus of protest against the burden of property taxation, and a dangerous trend toward advocacy of a general sales tax has resulted. The gasoline tax, seemingly the simplest of all sales taxes, is the entering wedge. A broader movement to replace taxes on property by taxes on the fruitful use of property—to tax activity and leave stagnation untaxed—is certain to follow the success of present attempts at gas-tax diversion. All, therefore, who have reason to fear the advent of sales taxation are concerned in the current winter's campaign. They should line up shoulder to shoulder with the road users in the fight.

Briefer Notes

An Emergency Met

BY MEETING successfully the emergency of a deep snowfall the state highway departments of the two Carolinas two weeks ago distinguished themselves with a highly creditable performance. Snow is rare in those latitudes, and snow-fighting equipment is not kept on hand. The phenomenal storm of Dec. 17, with a fall of ten to thirty inches over a large part of a state, would have been serious even in the snow belt; coming hundreds of miles below the Mason and Dixon line it created a major emergency. Yet the Carolina road forces, lacking all tools or training, set about their novel task with ingenuity and energy, and succeeded in clearing all their main roads in less than forty-eight hours. Adaptation of maintenance equipment was the means by which they succeeded. Their achievement stands as a model of what resourcefulness and organization can accomplish. The success of the road network as a transportation medium will always depend on administration vitalized by these qualities.

Licensing Drivers

A MEASURE for traffic safety which 27 of the 48 states have not provided is a driver's license law. In states where strong laws exist and are enforced, the record of accidents chargeable to incompetent and careless drivers has become continuously smaller. While in many of the states which require driver's licenses the laws are not as strong as they might be, observation indicates that the secret of success is strong enforcement. A weak law rigidly enforced is generally a better accident preventive than a stronger law weakly enforced. Another fact to bear in mind is that licensing drivers is a safety measure and not another means of securing income from the already well-taxed automobilist. Some of the states which have been most successful in their license regulation of drivers charge fees of less than a dollar a year. Driver's license legislation will come up for consideration in many of the state legislatures which will be in session this winter. Public-roads officials and civic organizations have the duty of making sure that it receives attention.

Energy and Backbone

AS THE largest factor in public-works extension, road construction is in a position of exceptional responsibility this year. Federal-aid work is to be almost doubled, to provide work for more men in the actual field operations and to help revive industrial activity by calling for more manufactured material and machinery. If this aim is to succeed, the conduct of the work must meet two imperative requirements: Work must be started at the earliest possible date, and it must be performed by efficient methods. Both requirements demand an unusual degree of energy and firmness on the part of the engineers in charge. They must plan and act with energy in order to get road work under contract at the earliest possible date, for every day that relief of unemployment is deferred the problem becomes more serious. In the performance of the work they must be firm to insist on the most efficient methods. Maximum relief will result from doing the largest amount of road construction with the money available and this means that every dollar must be applied in such a way as to yield the maximum result on the road. Further, the enlarged expenditure will be constructive in proportion to the extent to which it utilizes established agencies and channels of business, and on the other hand will tend to be disruptive and harmful if it departs from normal procedure. Responsibility for maintaining efficient construction in the face of manysided demands for resort to special expedients rests on the engineers and officials of the highway organizations through the country.

Great Road-Building Years

A REMARKABLE year in highway building has ended, and a year which promises to be even more remarkable is beginning. In 1930 approximately 6,000 miles more of state highways were constructed than were constructed in 1929, and it is estimated that 50,000 more men were employed in road work. The year 1931 begins with more road-building money definitely approved for expenditure than ever before, and larger mileages of improved roads contemplated. State-road improvement alone bids fair to approach the billion-dollar mark. These are not visionary figures; they are conservative appraisals of the cost of roadway construction and upkeep and of the highway bridge building now in sight, without a single dollar provided in addition to the sums already appropriated from the federal treasury and guaranteed by the taxes and license fees now in force in the states. When, a week hence, the highway industries of the nation congregate at the annual convention and equipment exhibition of the American Road Builders Association they will have in retrospect a year of road construction which may justly be viewed with pride, and in anticipation a year of even greater road-building activity. They will also have full assurance that the technique of road building has progressed as actively as ever in the past. There need be no fear that highway improvement is not going ahead or that the people will fail to provide ample money for all legitimate future extensions of public-roads improvement. The great concern in the road-building industry need be only that taxes now cheerfully paid for road service may be so diverted to other uses that opposition will come from the very interests which now support them.

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Engineering News was founded in 1874 by George H. Frost, as The Engineer and Surveyor, which title subsequently became The Engineer, Architect and Surveyor, then Engineering News and American Railway Journal and finally Engineering News, under the editorships of D. McN. Stauffer, A. M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as The Plumber and Sanitary Engineer. The name was subsequently changed to The Sanitary Engineer, Engineering and Building Record, and finally, to Engineering Record. During his ownership of the paper Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor of the paper in 1902 and was succeeded in 1913 by E. J. Mehren.

E. J. Mehren became editor of Engineering News-Record at the time of the consolidation in 1917, and was succeeded by Frank C. Wight in 1924. In July, 1928, F. E. Schmitt was appointed editor.

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The Traffic-Safe Road Is Today's Task

Greatest of Modern Highway Engineering Problems Center on Safety Considerations — Inaccurate Accident Statistics Are a Handicap to Solution—Primarily Safety Must Be Built Into the Road—Regulation Must Assist Safe Construction and Maintenance

By Samuel Eckels
Chief Engineer, Pennsylvania Department of Highways, Harrisburg, Pa.

THE traffic problem of today is to move millions of motor vehicles over the highways—to move them in the shortest possible time, over the most direct route, with a minimum of transportation cost and, above all, with safety.

The traffic-safety problem with which this discussion will deal is that which exists on highway outside of city streets. In the larger metropolitan areas traffic may be said to have reached practically its maximum development under present conditions, and the problem there is a special one, requiring special treatment. There is, however, an ever-increasing congestion on highways outside of the cities which presents perhaps a more diversified traffic problem for consideration.

Highway Deaths Growing Rapidly

Year	Total Number of Accidents	Total Number of Fatalities	Total Economic Loss
1929	1,860,000	31,000	$850,000,000
1928	1,677,969	27,966	769,000,000
1927	1,551,060	25,851	710,000,000
1926	1,410,540	23,509	646,000,000
1925	1,315,560	21,926	602,000,000
1924	1,161,360	19,356	532,000,000
1923	1,104,960	18,416	504,000,000
1922	920,640	15,344	421,000,000
1921	837,360	13,956	383,000,000
1920	753,420	12,557	346,000,000
1919	669,240	11,154	306,000,000

Highway improvements have done much in recent years toward eliminating certain factors known to be productive of a high accident expectancy. Curves and grades have been reduced. The width of road surface has been increased and pavements more generally superelevated on curves. Guard fence standards have been greatly improved, and there has been a marked increase in the efficiency of signs and of marking highways. The reduction of crown has increased the safety factor.

In spite of these improvements, however, and in spite of great modification and refinement in motor vehicle design and construction, the annual accident loss is not decreasing. On the contrary, it appears at the present time to be increasing at a rate in excess of the rate of increase in motor vehicle registrations.

If this annual highway accident loss be regarded as excessive, and if it is to be reduced, recourse must be had to traffic control. This control, however, must be so planned and imposed with reference to intelligent information derived from careful investigation that there may be close coordination between highway design, highway construction and traffic control. Safety is imperative, and traffic regulation of one kind or another is an absolute essential of safety.

Accurate information of accidents is lacking. The standard questionnaire now in use in Pennsylvania for accident reporting does not bring out all the information needed to allow a comparative study of conditions which cause accidents.

Accident reporting is comparatively new and must be further developed to be of practical aid in the design and construction of highways. If accurate reports were readily available and kept on the basis of the relation of location and road conditions to the cause of the accident, it would be less difficult to determine that a certain curve must be eliminated, or a certain intersection changed because of its high accident experience. Such statistics would be an invaluable aid in determining whether to place special emphasis upon the reduction of grades or upon the safeguarding of tangents.

It should be said, moreover, that if these reports are not made absolutely confidential the accuracy with which the circumstances are given is open to serious question. It will be futile to hope for accurate reports if the information contained therein is to be made the basis of punishing the person who gives it, or if it is to be available in any way for use in a damage suit against him.

Under the present system it is not even possible to obtain accurate information as to the number of accidents occurring on rural roads as distinguished from city accidents. If a bridge or culvert is washed out on federal route 60, 200 miles west of Ponca City, causing an accident, the victim is rushed to the hospital in Ponca City. If the victim dies, it is reported that he died in Ponca City as the result of a motor vehicle accident. Occurrences of this sort are so frequent that the reports are almost valueless to assist in rectifying the road condition that may have been a primary cause of an accident.

An analysis of a number of accidents due to road conditions showed the results given herewith.

The modern highway has many qualities: strength, durability, utility, efficiency and beauty. Millions of dollars are expended annually to secure the best in materials and construction methods which will definitely assure these qualities in the finished product. There is one quality, however, which is paramount in importance to all of these and without which the money expended on the others is purely waste; that quality is safety, and the highway which does not include it is a prolific source of economic loss.

Good engineering in the design and construction of the highway is the only means of assuring the quality of safety in the completed structure. Money spent on competent engineering has a direct reflection in economic gain to the future users of the highway. It is of no advantage to have the best in materials and construction methods unless they are combined by intelligent engineering into a structure which realizes its full possibilities.

The volume of automotive traffic on our highways has grown in recent years to proportions which are almost incapable of comprehension. If the traveling public were not essentially careful, the accident total would be stupendous. It is far too large as it is and demonstrates the need for safety which is built into road and bridge structures where it cannot possibly be ignored or lost through careless operation. This method is fortunately coming into more general use.

The alternative method, more generally practiced, is to accept the highway in the condition in which it is found and to impose artificial restraints upon the use of motor vehicles operated over it. Improvements are made to the surface of the highway such as the installation of proper drainage and the placing of a hard-surface pavement. A few curves may be straightened where that does not involve too great expense; a few grades may be lessened, with the same qualification. The construction dollar is stretched to cover the greatest possible number of linear feet of pavement. No attempt is made to superelevate curves or to flatten grades to a safe sight standard.

After the road is completed, attention is turned to the prevention of accidents, and the safety expert undertakes the task of promulgating and enforcing an elaborate system of prohibitions upon the use of the highway by motor vehicles. It is found that the smooth pavement tempts the motorist to speed, and speed increases the accident hazard.

Regulation is the only alternative; consequently the permissible speed is reduced to a point where accidents

Pennsylvania's Accident Record for 1929 Analyzes Causes

1. Summary of Accidents by Type of Accident and Age of Person Killed or Injured

Type of Accidents	No. of Accidents	Previous Yr. All Ages	No. of Persons Killed						No. of Persons Injured					
			All Ages	0-4	5-14	15-54	55 and Over	Not Stated	All Ages	0-4	5-14	15-54	55 and Over	Not Stated
0. Collision with pedestrian	10422	6307	1030	87	301	307	277	58	9712	789	3963	2706	1063	1191
1. Collision with automobile	25799	17340	366	6	20	270	37	33	19379	449	1312	14042	1509	2067
2. Coll. with horse-drawn vehicle	378	246	12			7	5		258	1	21	140	48	48
3. Collision with R.R. train	364	203	87	2	5	59	8	13	288	8	8	226	18	28
4. Collision with street car	916	593	34	1	2	26	1	4	705	9	47	502	48	99
5. Collision with other vehicles	122	189	7			7			123		7	107	1	8
6. Collision with fixed object	3150	1721	198	4	9	148	20	17	2673	40	153	2044	189	247
7. Collision with bicycle	489	220	17	1	9	7			485	9	279	152	4	41
8. Non-collision accident	1976	734	229	5	11	160	28	25	1983	31	104	1512	195	141
9. Miscellaneous	160	81	12			8	1	3	42	3	7	27	2	3
Grand total	43776	27634	1992	106	357	999	377	153	35648	1339	5901	21458	3077	3873

8. At Railroad Crossings	No. of Accidents		
	Total	Fatal	Non-Fatal
1. Guarded crossing, man on duty	24	4	20
2. Guarded crossing, automatic signal	10	2	8
3. Unguarded crossing	70	7	63
4. Not stated	260	53	207
Totals	364	66	298

9. Property Damage	0-50	50-150	150-250	250-500	Over 500
1. Damage to Motor Vehicles	4355	14854	5495	3756	3046
2. Damage to other than Mv's	1196	320	65	18	15
	5551	15174	5560	3774	306

2. Hour of Occurrence	No. of Acc'd'ts		
	Total	Fatal	Non-Fatal
12 to 1 a.m.	1101	41	1060
1 to 6 a.m.	2228	113	2115
6 to 7 a.m.	644	32	612
7 to 8 a.m.	820	24	796
8 to 9 a.m.	1153	49	1104
9 to 10 a.m.	1156	36	1120
10 to 11 a.m.	1591	67	1524
11 to 12 a.m.	2081	70	2011
12 to 1 p.m.	1865	79	1786
1 to 2 p.m.	1930	51	1879
2 to 3 p.m.	2398	89	2309
3 to 4 p.m.	2829	97	2732
4 to 5 p.m.	3935	238	3697
5 to 6 p.m.	3888	164	3724
6 to 7 p.m.	3316	164	3152
7 to 8 p.m.	3200	140	3060
8 to 9 p.m.	2921	125	2796
9 to 10 p.m.	2589	129	2460
10 to 11 p.m.	2091	86	2005
11 to 12 p.m.	2039	91	1948
Not stated	1	1	
Totals	43776	1886	41890

4. Description of Drivers Involved in Automobile Accidents	No. of Drivers		
	Total	In Fatal Accidents	In Non-Fatal Accidents
Driver's Sex			
Male	66997	2131	64866
Female	4204	90	4114
Not stated	328	15	313
Driver's Age			
Under 18 yr	1998	69	1929
18 to 24 yr	18816	639	18177
25 to 54 yr	39840	1102	38738
55 and over	3536	99	3437
Not stated	7339	327	7012
Driving Experience			
0. Less than 3 mos	1774	58	1716
1. 3 to 6 mos	903	26	877
2. 6 to 12 mos	2143	54	2089
3. 1 yr. or more	58097	1524	56573
4. Unlicensed	28	5	23
5. Out of state	2		2
8. Not stated	8582	569	8013
Total No. of drivers	71529	2236	69293
Cond. of Motorist			
0. Intoxicated	132	13	119
1. Physical defect	45	2	43
Not stated	43599	1871	41728
Total	43776	1886	41890

6. The Motorist Violations	Total	In Fatal Accidents	In Non-Fatal Accidents
1. Exceeding speed limit	5234	129	5105
2. On wrong side of road	6093	80	6013
3. Did not have right of way	4301	42	4259
4. Cutting in	3095	41	3054
5. Passing standing st. car	95	3	92
6. Passing on curve or hill	438	6	432
7. Passing on wrong side	203		203
8. Failed to signal	1404	7	1397
9. Car ran away—no driver	46	2	44
10. Drove off roadway	4555	325	4230
11. Miscellaneous	2964	142	2822
12. Not stated	9758	701	9057
13. No violation	5590	408	5182
Totals	43776	1886	41890
Direction of Travel			
0. Going straight	33116	1515	31601
1. Turning right	637	12	625
2. Turning left	2243	43	2200
3. Backing	331	5	326
4. Car parked or stand'g still	385	14	371
5. Slowing down or stopping	727	10	717
6. Skidding	4387	145	4242
Not stated	1950	142	1808
Totals	43776	1886	41890

10. The Pedestrian	No. of Acc'd'ts Inv. Pedestrian		
	Total	Fatal	Non-Fatal
Crossing at intersection			
0. (a) with signal	25	1	24
1. (b) against signal	305	9	297
	9		9
2. (c) no signal	29	2	7
3. (d) diagonally	1017	90	927
4. Crossing between intersections	141	7	134
5. Waiting for: getting on-off st. car	45	9	36
6. Standing on safety aisle	72	7	60
7. Getting on or off other vehicle	1881	101	1785
8. Children playing in street	62	3	59
9. At work in roadway	144	34	110
10. Riding or hitching on vehicle	52	4	48
11. Not on roadway	1531	141	1390
12. Coming from behind parked car	3821	398	3423
13. Miscellaneous	1287	219	1068
Totals	10422	1025	9397
11. Condition of Pedestrian			
0. Was intoxicated	212	17	195
1. Had physical defect	20	5	15
2. Was confused by traffic	681	78	603
3. View obstructed	1081	123	958
Not stated	8428	802	7626
Totals	10422	1025	9397

3. Day of Occurrence	No. of Accidents		
	Total	Fatal	Non-Fatal
1. Sunday	8969	382	8587
2. Monday	5598	272	5326
3. Tuesday	5182	221	4961
4. Wednesday	5340	236	5104
5. Thursday	5600	228	5372
6. Friday	5236	208	5028
7. Saturday	7848	339	7509
8. Not stated	3		3
Total	43776	1886	41890

5. Nature of Injuries	Number of Persons Injured
0. Fractured skull	466
1. Fractured spine	1
2. Other fractures	2175
3. Concussion of the brain	104
4. Severe general shock	14407
5. Slight shock and shake-up	1196
6. Internal injuries	348
7. Other injuries	16262
8. Not stated	689
Totals	35648

7. Road Location	Total	Fatal	Non-Fatal
0. Between intersections	871	90	781
1. Rural intersections	192	6	186
2. State highway	23515	1127	22388
3. Driveway	33	1	32
4. Curve	5328	231	5097
5. Street intersection	13045	308	12737
6. Railroad crossing	377	67	310
7. Bridge	347	14	333
8. Not stated	68	42	26
Totals	43776	1886	41890

12. Types of Vehicles Involved in Accident	No. of vehicles Involved		
	Total	In Fatal Accidents	In Non-Fatal Accidents
0. Passenger car	56665	1527	55138
1. Commercial car	7355	309	7046
2. Taxi	792	10	782
3. Omnibus	530	21	509
4. Motorcycle	660	61	599
5. All others	35	1	34
8. Not stated	5492	307	5185
Totals	71529	2236	69293

are less likely to occur. Curves, grades and intersections all take their toll of traffic time as potential danger points, and the aggregate of time lost is a considerable item.

It is possible to design and build a highway which is essentially safe for traffic under all known conditions and at all speeds. Certain traffic hazards are known to produce a definite proportion of accidents. They must be eliminated.

It would of course be practically impossible to prevent all motor vehicle accidents. So long as man sees fit to scorn the means of locomotion provided by nature and propels himself by mechanical devices of his own production there will always be what may be termed "unavoidable accidents." There will also be a certain percentage of avoidable accidents which cannot be prevented. The chap who rocks the boat for fun and pulls the trigger to prove that the gun is empty is still with us. He has an automobile now and regards it as his sacred and inalienable privilege to operate it after his own peculiar fashion. The wisest man living or yet to live could not devise a highway so nearly foolproof as to prevent the so-called accidents in which this type of driver will participate. But highways can be so designed and constructed as to prevent practically all accidents to drivers who possess and use an average amount of intelligence in operating a motor vehicle.

Curves and Grades Are Shown to Promote Accidents

	Straight Road	Light Curve	Sharp Curve	Light Grade	Heavy Grade
Accidents	520	254	213	141	149
	53%*	26%	21%	49%	51%
	Tangent, 363,823 ft.	Curve under 10°, 170,070 ft.	Curve 10° or more, 13,927 ft.	Grade under 6%, 384,418 ft.	Grade 6% or more, 163,402 ft.
	66%	31%	3%	83%	17%
Factor	80	84	700	59	300
Ratio	1.00	1.05	8.75	1.00	5.08

*Percentage determined by analysis of a composite sample comprising plans for 103 miles of state highways in Pennsylvania.

As has been stated, the method of securing safety by restraint of traffic is most generally practiced. It is also the less efficient, and far more costly from an economic viewpoint because its essential theory of safety is the retarding of traffic movement.

Delay in transportation means a serious economic loss. The cost may be charged against reduction of the accident cost, and the loss to business appears excusable. When we learn, however, that the accident cost may be reduced without the necessity for delay it becomes a preventable cost which must be eliminated.

Preventable delay occupies a relationship toward transportation similar to that of friction toward moving machinery. Its elimination represents a legitimate business cost with a definite monetary saving to industry. A specific example appears in the case of building contracts where delay is so universally penalized by liquidated damages. When the builder is assured of the elimination of preventable delay in the transportation of materials, a considerable saving in building cost will be effected. Preventable delay is pure economic waste, since it is every man's loss and no man's gain.

Safety is an absolute essential in transportation, for if the accident cost is high no ultimate saving is effected. It is readily apparent that safety is entirely consonant with maximum speed and efficiency in traffic movement when speed, with safety, is designed and built into highways.

These are the new problems which are developing and confronting the engineers who must design and build modern highways. Reduction of the accident hazard is vital, but that reduction must be accomplished without resorting to the medium of delay. We have progressed beyond the point where highway engineering contemplates only a road which will carry traffic with a low maintenance cost. The demand now is for highways designed and built from the standpoint of the highest possible traffic efficiency; highways on which delay, misdirection and accident hazard are practically unknown.

The highways of the future must be so designed and built that varying weather conditions will have a minimum of control over traffic movement. The effect of rain, snow, sleet and fog upon traffic must be studied and eliminated as a traffic hazard. All-weather highways are needed for all-weather business.

Bridges are no longer sufficient if they merely assist in crossing streams. They must be so designed and built that they will carry the heaviest loads in absolute safety and without delay.

Curves must be eliminated wherever possible, or so developed that they represent no hazard. Every curve presents its individual problem, requiring special treatment, but all curves must be held to a uniform standard of speed with safety.

Grades must be kept to a uniform standard where they become a known factor in figuring load and motive power. The summit of every grade must be flattened to an adequate safe sight distance.

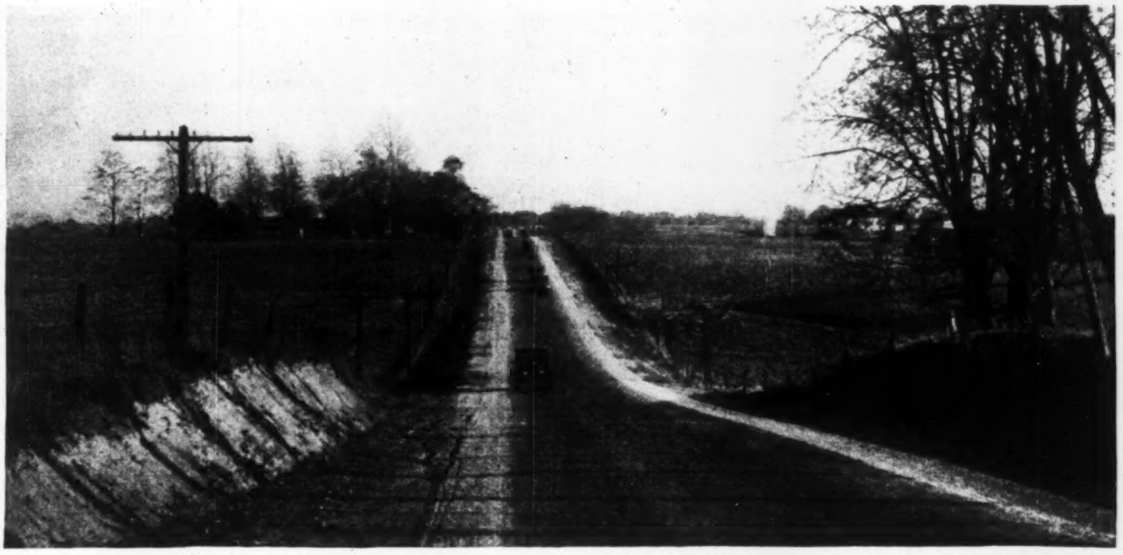
The rapidly increasing accident toll from collisions is sounding the death knell of two-way traffic on the open road, and of unguarded intersections.

Experiments in new forms of construction are being carried out in nearly every section of the country, and information of inestimable value is being compiled. Road hazards of types that were familiar a few years ago are fast disappearing from the highways. The traveling public is learning to think in terms of traffic safety and highway efficiency, and as the general public becomes more and more the traveling public and its perception of the problem more accurate there is more general recognition of the fact that the first cost of highway construction is secondary to considerations of safety and that the ultimate cost justifies the elimination of preventable accident and delay.

There is no single issue of greater importance which faces the public today, for with 26½ million automobiles registered in the United States it is apparent that conditions which affect their operation must have an influence upon the lives and business of a majority of the population. The concentration of raw materials and the distribution of food and manufactured products is in a very large measure dependent upon automotive transportation.

The public is becoming cognizant of these facts and also of the fact that since 1913 the annual total of reported motor vehicle fatalities has increased from 4,227 to 31,000. This is equivalent to wiping out the entire population of a city every year.

Traffic-safe highways must materially decrease this total and at the same time prevent needlessly costly delays. Certainly this is what all of the people earnestly desire, and while progress is being made along such lines it is at present all too slow to keep pace with the increasing problem of accident and congestion. The utmost and best in engineering skill is demanded, and the need is immediate and compelling. We must design and build the traffic-safe highway of tomorrow, now, today.



White Aggregate at Pavement Edge Aids Night Driving

Maintenance Must Keep Roads Safe

By A. H. Hinkle
Superintendent of Maintenance, Indiana State Highway Commission, Indianapolis, Ind.

Maintenance must accept the legacy of hazards which construction has left and nature imposes and so minimize them that traffic is not endangered

TRAFFIC SAFETY can be greatly aided by appropriate maintenance methods and practice. These methods have to do with: (1) Preserving a smooth riding surface; (2) preventing a slippery surface; (3) shoulder maintenance; (4) cutting weeds and brush and trimming trees and shrubs; (5) maintenance of signs, signals and pavement marking; (6) the relative development of the different parts of the highway; (7) emergency work in clearing roads, directing and aiding traffic during or after emergencies such as wind storms; floods, snow storms and accidents.

For safety, modern road maintenance must do more than merely maintain, for two reasons: (1) Traffic has so increased in quantity, speed, and length and size of vehicle that a road safe yesterday is short of the requirements of today; (2) construction defects and shortcomings invariably occur in the best of our highway programs; hence, the odds and ends omitted in the construction of the road must be cared for and each year a wider pavement and a greater sight distance must be provided on curves.

It may be more economical in many cases, and is a possible aid in financing, to widen the metal on the inside of curves each few years, or gradually to widen dangerously narrow fills with dirt hauled from the cut bank on the inside of a curve, thus increasing the sight distance a small amount each year, than to perform the work in one major operation. By making these additions as needed, finances are able frequently to keep up with the traffic demands; whereas, if the work is all performed in major operations, limited finances may delay the elimination of many dangerous features, until long after they become hazardous. Hence, in actual practice the maintaining of a highway safe for its traffic, in a major sense, must include not only the routine upkeep operations but also the odds and ends left over by the construction operations, together with the gradual expansion of certain features made necessary with the ever-increasing quantity and speed of traffic. These accessory features are necessary to insure a reasonably free and safe flow of traffic over the highways.

Preserving a Smooth Riding Surface

Modern highway transportation demands that a smooth riding surface be maintained. This not only accelerates traffic and saves wear and tear on vehicles and their cargo but also may prevent accidents. Great improvements in motor vehicles in recent years have stepped up their speed so that it becomes more important that isolated rough spots in the surface be eliminated. Also road-maintenance methods have so developed in recent years that it is a simple matter to plug up any holes or fill any depression in a pavement with one of the many bituminous mixes or a quick-hardening concrete. Speed in making these patches on the heavy traffic roads is exceedingly desirable. The repair work not only interferes with the traffic but it is a hazard to workmen on the road, as well as to the traffic itself. Often the value in the expenditure of the small additional funds necessary to speed up the work is not recognized. This failure is sometimes due to those directly responsible for the work and at other times to those having to do with the appropriations. Too much emphasis cannot be placed on doing with dispatch extensive repair work on the heavily traveled roads.

Avoid Slipperiness on Pavements

While a smooth riding surface should be maintained, it is even more important to avoid slipperiness. The dripping of oil from motors on a hard surface may be sufficient on a heavy traffic road to produce a greasy slippery surface. This condition is reduced by a wider pavement which scatters the oil. Sand, finely crushed cinders or other kinds of grit spread on the surface will reduce the slipperiness, and the expense, occasionally during the heaviest touring season when the slippery condition it at its worst, may be fully justified on high-speed heavy-traffic roads. This grit not only produces immediate effect but it mops up a certain amount of the oil and leaves a lasting value.

Roads maintained with bituminous treatments by the use of proper amount and correct grade of bitumen and covering aggregate can be made non-skid. There are so many variations in amounts and kinds of material that can be used that they will not be described here. While either gravel or crushed slag or stone may be used, the crushed aggregate with its sharp angles produces the more non-slippery surface. Also the harder the aggregate the more non-skid is the surface produced. The degree of roughness will vary with the size of the aggregate. The method of bedding $\frac{3}{4}$- to 1-in. size hard aggregate (or larger if a soft bituminous mat of some depth is on the surface) into a bituminous surface by the use of a roller is a very effective way of reducing slipperiness. In attempting to produce a non-skid surface with bituminous treatments it is imperative to prevent the bitumen from later coming through the aggregate under heavy traffic and again forming a slippery surface. To avoid this it is necessary that all the covering that will be held by the bitumen be applied and that it becomes glued to the surface either by traffic or the use of a roller in warm weather. To accomplish this it may be necessary to scrape the loose aggregate brushed from the surface by traffic to the side of the road, back onto the surface several times. This should be done in warm weather when it will be held better by the soft bitumen.

If a light grade of tar, oil or cutback asphalt is used, best results will come from putting on only enough covering at first to be securely glued to the surface when the bitumen hardens, and then just before the bitumen is too dry to absorb it an excess of covering should be added to produce a dry non-skid top. With these light grades of bitumen a final application of coarse sharp sand may be used.

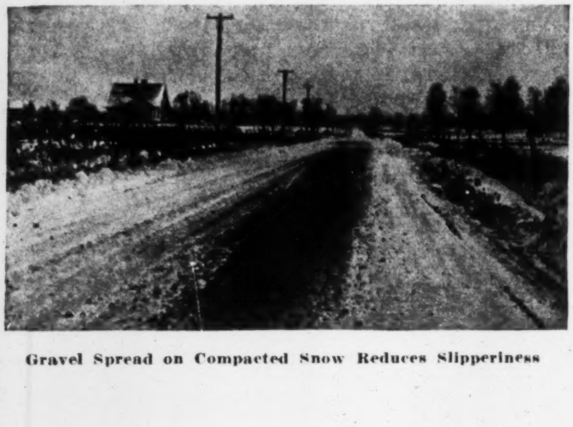
It is not generally practicable to treat the entire surface of a large system of rural roads when they are covered with ice. It is, however, necessary to treat certain places such as curves, steep grades, intersections, approaches to railroad crossings or other places where traffic is required to stop suddenly. This is more necessary when most of the road is in good riding condition. When the larger part of the road surface is suitable for high speed, unexpected slippery places become very hazardous.

A suitable method for reducing the slipperiness of an icy surface is to sprinkle over it some form of grit such as ashes, cinders, fine crushed stone, gravel or sand. Calcium chloride and common salt are sometimes used. The latter two materials should be used in limited quantities as they may later cause disintegration of a concrete surface and do damage to other types as well as to the roadside planting. Furthermore, during extreme cold the slight thawing due to calcium chloride may freeze hard and the road becomes temporarily slicker than an untreated ice surface.

Reducing Slipperiness on an Icy Surface

Cinders alone make an excellent grit to reduce slipperiness on ice. When mixed with calcium chloride at the rate of about 100 lb. of calcium chloride to 2 to 3 cu.yd. of cinders, better results are secured. The calcium chloride may be used in either granular form or in solution (about 100 lb. to 13 gal. of water) sprinkled over the pile or load of cinders. The effect of the calcium chloride is to make the cinders stick to or set in the icy surface, thus immediately reducing the slipperiness. Also the calcium chloride will aid in preventing the cinders from freezing, thus making them more accessible when most needed. If dry calcium chloride is used, it usually can be sufficiently well mixed by sprinkling it over the cinders in the trucks as the cinders are spread on the surface. The cinders may be stocked beforehand in piles along the roadside in the vicinity of the grades and curves or where most likely to be needed. They will then be available when the ice comes which may handicap hauling them until the surface is treated in places.

On gravel roads that are slippery from an ice sheet of compacted snow, frequently ordinary maintenance gravel or stone may be spread on the surface and satisfactory results secured. When the thaw comes the gravel is left on the road surface where it serves as maintenance material, thus adding little to the additional



Gravel Spread on Compacted Snow Reduces Slipperiness

Stone Shoulders Treated With Asphalt

cost by using it to reduce slipperiness. Even on pavements such material finally lodges on the road shoulder where it is of some value.

Shoulder Maintenance

Road shoulders serve as safety valves on which to turn in case of emergencies. Hence, their proper maintenance, free from ruts, is imperative. They should be wide and slope gradually to the ditch without a sharp break, not only for safety but so that machine mowing can be done to beyond the ditch. If the shoulders are not so built in the first instance, they should be reshaped to conform with this section. Deep ditches still rank high as a contributing cause to accidents on rural highways.

Ruts on the edge of the pavement are a cause of many accidents. Where the traffic for the width of pavement is heavy so that common earth shoulders are not sufficient, stone or gravel rather than earth should be used to fil these ruts. This metal will also furnish an approach to aid the wheels in climbing back onto the pavement when the earth shoulders are soft. In extreme cases of needed width, particularly with sand shoulders, a 2- to 4-ft. metal strip 5 to 7 in. deep, on which is built one of the cheaper bituminous surfaces, has been used to very good advantage.

Since the high-speed traffic and laws of many states make it hazardous to park vehicles on the pavement, it is extremely desirable to place sufficient metal on the shoulders to a width of 6 to 8 ft. at stated intervals for parking. This may prevent many fatalities resulting from collisions with crippled vehicles parked on the pavement, which have no other safe available place in the vicinity to stop.

Cutting Weeds and Trimming Trees and Shrubs

Grass, weeds and brush must be cut for safety. This is extremely necessary on the inside of curves to give longer sight distance. It is necessary to keep them cut to beyond the ditch line so as to make visible culvert headwalls or other obstructions. Also live stock will frequently be unobserved in tall grass or weeds and suddenly run into the path of a swift-moving car. A clean shoulder and ditch will largely eliminate this trouble.

Trees must be kept suitably trimmed and only low-growing shrubbery permitted at intersections. Obstructed views at intersections from wild growth and cultivated crops have taken their toll. This hazardous condition is frequently prolonged because of a narrow right-of-way. Until a proper right-of-way is secured and the corners rounded off, the land owner should be encouraged to plant low-growing crops in the corners of the fields. Intersections of high-speed roads should have a clear view across the corner for at least 200 ft. back from the intersection. This is frequently aided by keeping relatively high grade lines at the intersection.

Maintenance of Signs, Signals and Markings

It is one problem to provide and erect in the first instance standard signs and signals. It is quite another problem to maintain them with a fresh coat of paint and keep them most visible. Any system of marking, it matters not how good when established, is of little value if the signs are allowed to become defaced and knocked down. Few things on the highway are shorter lived than the road signs. Hunters shoot them, boys deface them with stones and traffic destroys them. Hence, constant care is necessary to keep them in repair that they may be effective. On stretches of road subject to overflow by swift current, posts should be set to guide traffic during high water.

Pavements should be marked at approaches to railroad grade crossings and a center line displayed at least on curves, and better on the entire length of pavement.

Marking on the pavement is perhaps best made with a black bituminous material on all but a black-top pavement, where usually white or yellow paint is considered better. The black bituminous paints are more permanent and much cheaper than the white or yellow pavement-marking paints. For this reason some insist that the black paints are even more suitable than white paints on certain black-top surfaces. If an asphalt or tar paint is used on a black surface a comparatively heavy grade should be used which will permit a liberal quantity to be applied that will build up an appreciable thickness which makes the line more observable. For ordinary marking on a non-black surface a heavy grade of cutback or emulsified asphalt or medium grade of tar, placed during the cooler weather when the surface is dry, will give best results. If placed during the hot weather it tracks readily and requires a liberal application of covering of sand or other aggregate. If placed during cool weather little or no covering need be applied.

Culvert headwalls, bridge endposts, trees, poles, guard rails and other obstacles not practicable to remove outside the danger zone on the highway should be painted white. In the region subject to lengthy snow periods the top of guardrail posts should be tipped with black so that they may be more visible with a background of snow.

Public utility poles with which vehicles have collided have been the source of many bad accidents. Too often these are permitted within only a few feet of traffic, much of which is traveling 60 miles an hour. High-

Shoulder Ruts Filled by Box Spreader to Minimize Risk

Poor Shoulders Add Much to Traffic Costs

tension wires have been knocked down in a line of traffic. Poles carrying high-tension wires should never be closer to the edge of a high-speed pavement than 20 ft.

High-speed traffic has many times collided with trees causing serious accidents. While trees are extremely desirable along the highways and should be preserved wherever practicable, they have their limitations as to location. Here again the poles and trees cannot be where they belong because of an old-fashioned, too narrow, right-of-way.

Many of the rural highways have become, figuratively speaking, double-track high-speed railroads within the last decade so far as speed and safety is concerned. There seems to be no way to stop this speed or increase of traffic, nor is there any inclination to do so. Hence, we must get up to date on securing the necessary right-of-way on many of the old roads if the accident problem is to be combated.

Safe driving at night and during a rain is materially aided on a black surface by placing a strip of white crushed stone along the edge of the pavement. This serves the double purpose of guiding traffic and preventing a rut at the edge of the pavement.

Safety Organization

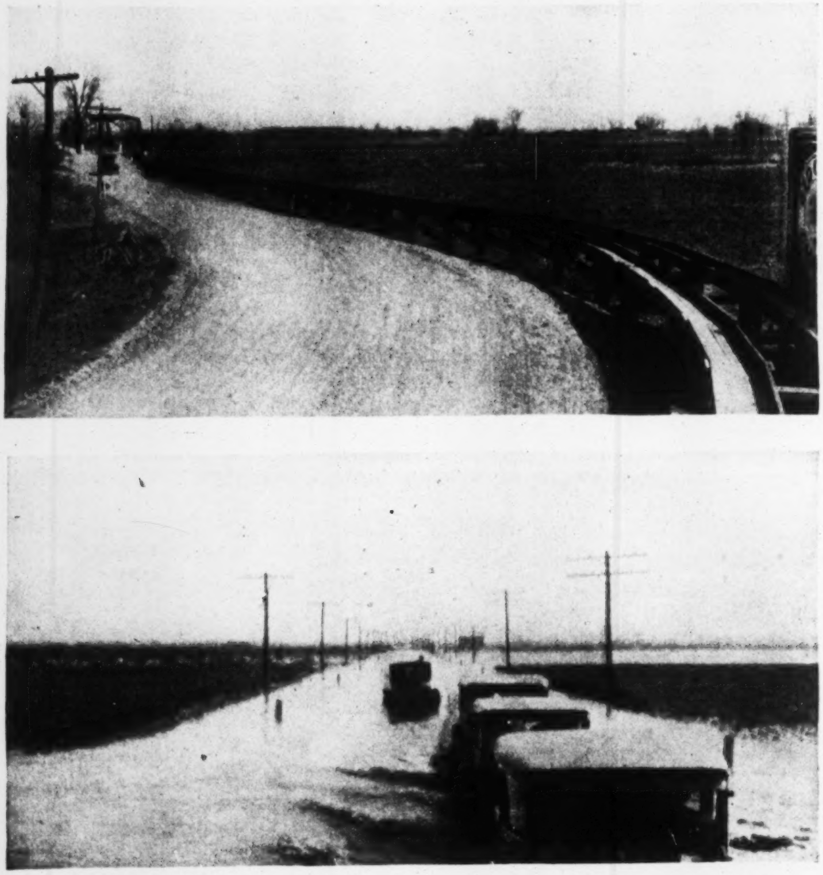
While a few specialists on safety are necessary in a highway organization, the bulk of the field work of keeping in repair and replacing safety signs must be done by the regular maintenance organization whose employes are available and sufficient in number to do this work. It is too costly to depend entirely upon special crews which should do only the special work. Also the specialists on the subject should furnish the necessary advice and instructions for the remainder of the organization. Frequently signing and marking is not done at all or is done at too great an expense, because of an impracticable organization.

Relative Development Important

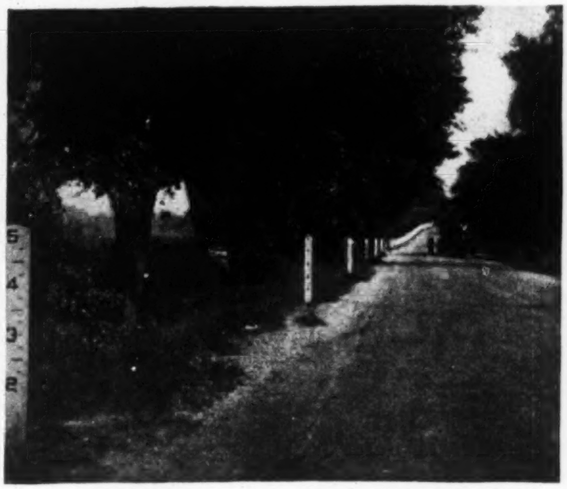
The relative degree to which the different elements of a highway are developed should be given much consideration. Under modern maintenance methods, with heavy machinery and long-base drags, it is possible to develop an exceedingly smooth riding surface on a secondary road that invites high speed. If on such roads there remain short sight distances, narrow bridges, sharp turns, steep grades, narrow fills and other hazardous places, the development of an unusually good riding surface may be a source of accidents. The relation of these hazardous places to long tangents and with each other will usually determine their degree of hazard. Hence, it is important that along with the making of a smooth riding surface, or better preceding it, these hazardous places be reduced. While signs are used as a warning of such hazards, and these should be properly displayed at all hazardous places, yet experience has shown that they have a limited value in preventing accidents.

Occasionally due to accidents, bridge failures or necessary construction and resurfacing work, it may become necessary to suddenly close one of the heaviest traveled main thoroughfares. This may require heavy traffic to go over a detour road which may be undeveloped and may have many dangerous, narrow grades, bridges, culverts, etc. Even though such a detour road is made smooth by proper dragging, it is very hazardous to the traffic, particularly because such traffic is accustomed to driving at high speed on the good highways and continues this speed on the short though hazardous detour.

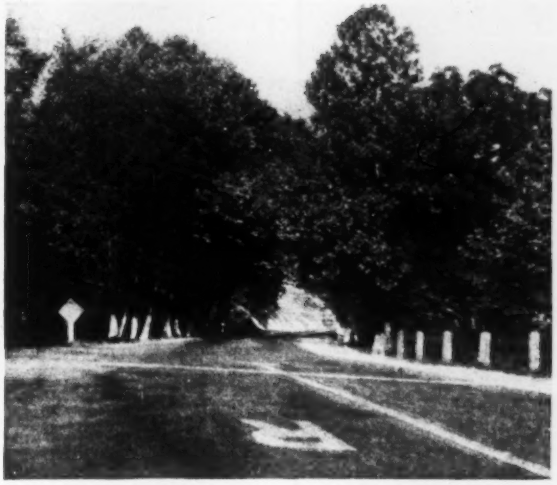
Hence, although it may be proper to have no speed limit on the main thoroughfares under normal conditions, it is exceedingly necessary as a matter of safety to have a speed limit on the dangerous detour. Highway officials should be permitted legally to establish a safe speed limit on detours and other dangerous roads by properly posting such roads. Likewise, traffic is frequently permitted to travel over a road under construction or extensive maintenance operations "at its own risk," with laborers scattered along the highway whose lives are endangered by the high-speed traffic. It may be



Overflow Conditions May Be Met by Providing a High-Water Trestle or by Using a Truck to Pull Automobiles Through Deep Water



Gage Posts on Roads Subject to Overflow Warn Motorist of Deep Water



White Guard Rails and Tree Trunks Mark Narrow Points on Roads

a great saving to the public to permit traffic under such conditions. Here again the highway authorities should be permitted to establish a safe speed limit by properly signing the road. Frequently workmen have been killed by this high-speed traffic rushing in upon them.

Emergency Work in Clearing Roads

Emergencies such as floods, accidents, wind storms and deep snows, require special work and attention as a safety feature in conducting traffic over the main highways. While such work might be classed under the heading operation, it is so closely allied with the maintenance work proper that it may be considered a subdivision of it. It is economical for the maintenance organization to handle such work because of the availability of its employees.

Where highways are flooded it is not only necessary to mark the border of the roadbed where swift-flowing waters cross them, but warnings should be placed when it is dangerous for a vehicle to attempt to drive through the water. Most up-to-date highway departments now maintain free service in pulling traffic through the floodwater after it is too deep for an automobile to safely navigate under its own power and before the water is so deep as to prevent a truck from pulling it through. This service frequently saves thousands of dollars to the state by preventing the maintenance of a long and poorly improved detour and also may save much more to the traveling public.

Bad accidents occur from one cause or another regardless of the condition of the highway. In order to avoid other and frequently more serious accidents, it is necessary that guards be placed, lights displayed at night and that the wrecked cars be removed from the highway surface. Trucks have wrecked bridges by striking the trusses or from overloading. Automobiles have been known to drive onto a wrecked bridge, broken down by a bus which was stranded in the stream channel. In order to prevent high-speed vehicles from running into the wrecked bridge, immediate action is necessary in the way of establishing guards, erecting signs and warning lights.

After every severe wind storm trees and other debris must be cleared from the highway to prevent the wrecking of cars. Telephone poles, wires and other obstructions must be cleared from the traveled way as soon as possible. Any up-to-date maintenance organization must be ready for such emergencies day or night.

While snow removal is a regular part of the upkeep of every modern system of main highways in the area subject to snow storms, there are occasionally such severe storms as to make it impossible to keep traffic moving. In such cases warning signs or guards should inform the traveling public that they can not get through certain blocked stretches of road, thus preventing the traffic from rushing in without this information and not only stalling in the snow and endangering the lives of the occupants but also blocking the road with stalled cars, which prevents efficient snow removal as soon as the storm subsides. The writer is familiar with instances where a full half day in zero weather has been required to pull stalled cars from the road before a snow plow could go through.

It should be added that it is necessary to educate the public to respect proper warnings, as often the drivers of cars give little heed to same and rush in only to their sorrow after they are stalled in a big drift. During severe storms in those areas where traffic persists in traveling, the highway official in charge should set up an information bureau which will receive by wire or otherwise prompt information about the changed conditions of the road. During such storms it may require but a short time for a road to become blocked. Constant communication should be kept with strategic points along the road in question so as to pass the information to those that can place the proper warning for the traveling public.

Probably the greatest barrier to economical snow-removal work has been the stalled vehicles in the drifts. It is imperative that a maintenance organization furnish the necessary information to prevent this waste of energy and exposure of vehicle occupants, as well as aiding in the speedy and efficient opening of the highway at the earliest possible data.

The above operations are just as necessary in preventing accidents, exposure and loss, as the maintaining of a smooth surface or wide and safe roadbed over which the traffic may go unobstructed.

Safety and Saving Follow Bypass Road Construction

Experience From a Score of Examples in New Jersey Shows Increasing Local Support and Gain in Traffic Volume, Speed and Safety

By H. W. Giffin
Field Engineer, New Jersey State Highway Commission, Trenton, N. J.

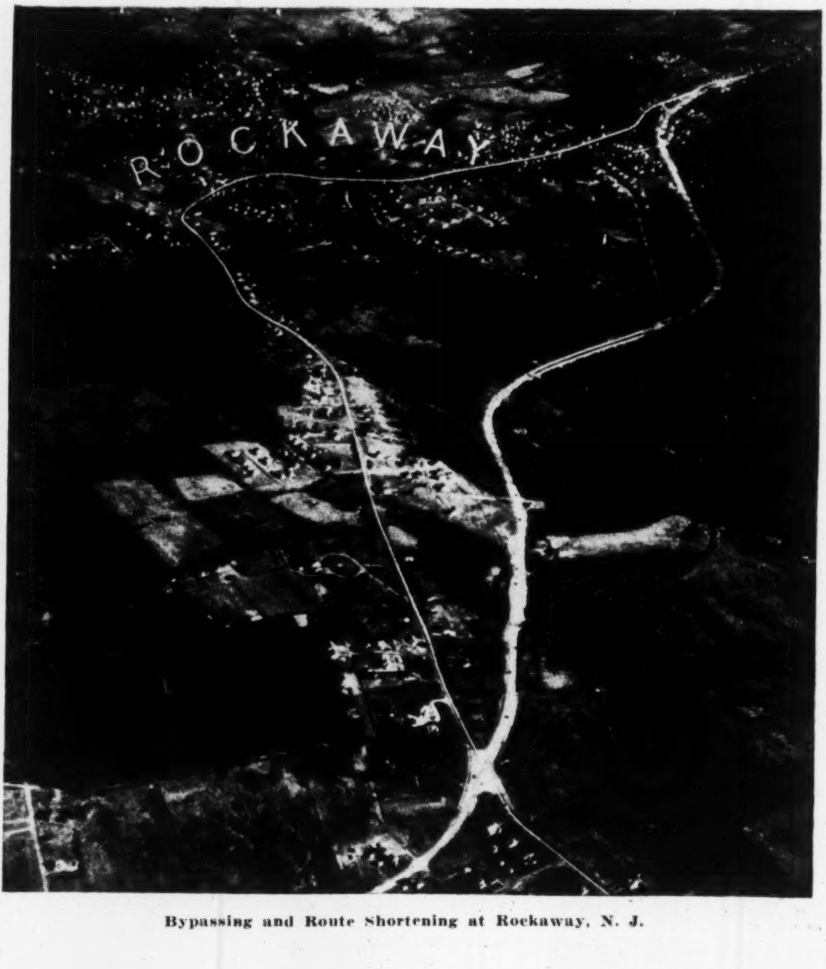
BYPASS highways perform many and various services. Most of them contribute to the safety of travel, although safety perhaps is seldom the impelling motive for constructing a bypass, which is often a highly expensive piece of road building. Generally the motive is expedition of traffic by shortening and straightening the road and separating through and local vehicle movements. Each of these services obviously increases safety, and this is always recognized as an important factor in appraising the need and value of a bypass and in planning its construction and structures.

To make the discussion definite and specific, a concrete example of bypassing practice has been selected. Bypassing centers of population is an established policy of the state highway department of New Jersey. Its advantages have been so well established that local objection to the diversion of traffic away from commercial centers is seldom great; more often the sentiment is that a business nuisance is thereby abated. In all, some score of towns and groups of towns have in the last few years been relieved of main through traffic by vertical bypass (elevated) roads and more commonly by horizontal bypassing or swinging the road around the town.

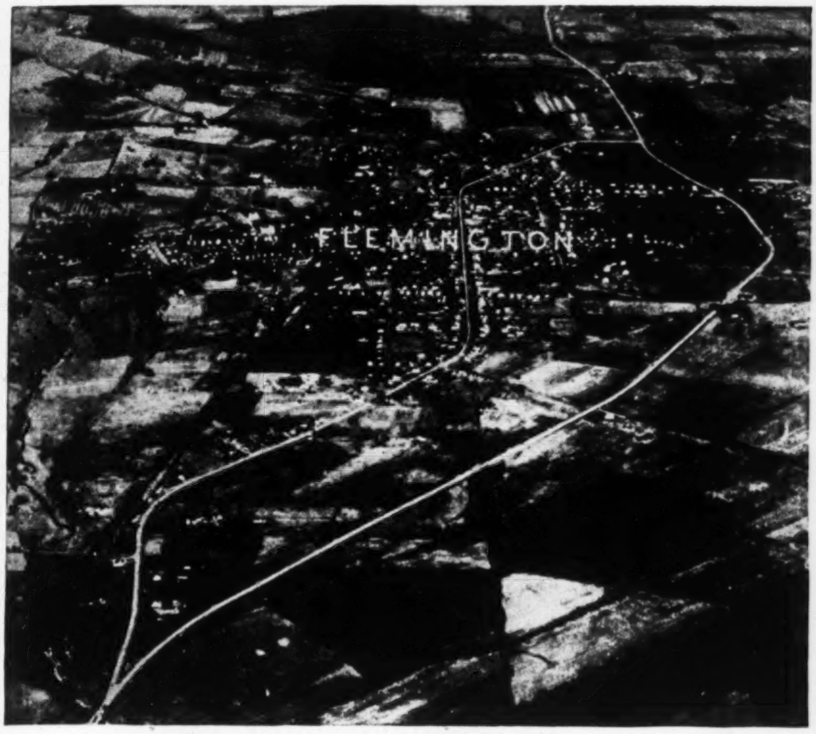
These examples give a classification of bypasses as follows: (1) Those which divert the main route from a center of population, and (2) those which provide a new route skirting several centers of population. Structurally there is also possibility of separation into two types (*a*) vertical bypassing by elevating the new road, and (*b*) horizontal bypassing by swinging the new route to one side. In general the bypasses of class 1 are employed where single and not generally large cities and towns are detoured and those of class 2 in metropolitan areas and where groups of towns have grown up in conjunction and form an extended series of merging settlements which have to be considered in mass in any question of diverting traffic.

The most common bypass road problem is to carry through traffic around a town; in many states having many scattered small cities and few or no large metropolitan areas it is virtually the only bypass problem. It is, therefore, given primary consideration. Accompanying sketch maps show actual single-town bypass constructed in New Jersey.

The purposes of these bypasses were: (1) shortening the distance for traffic destined beyond the town; (2) improving the alignment of the main route; (3) separating through and local traffic; (4) eliminating the costly operation of widening existing streets; (5) avoiding grade crossings of railways and street railways; (6) meeting the local demand for removal of through traffic from the town streets; (7) providing double traffic routes where needed, and (8) reducing danger to local traffic and pedestrians. Not all of these purposes were



Bypassing and Route Shortening at Rockaway, N. J.



Bypass Around Flemington Eliminates Two Curves

served in every instance, but usually most of them were. In all cases a large contribution was made to safety by shortening and straightening the road, by separating local and through traffic and by reducing the number of railway crossings at grade. The extent of these gains appears more directly from a study of the individual bypass. Only a few of these can be mentioned in detail, but the similar situations prevailing at others are made plain by the maps.

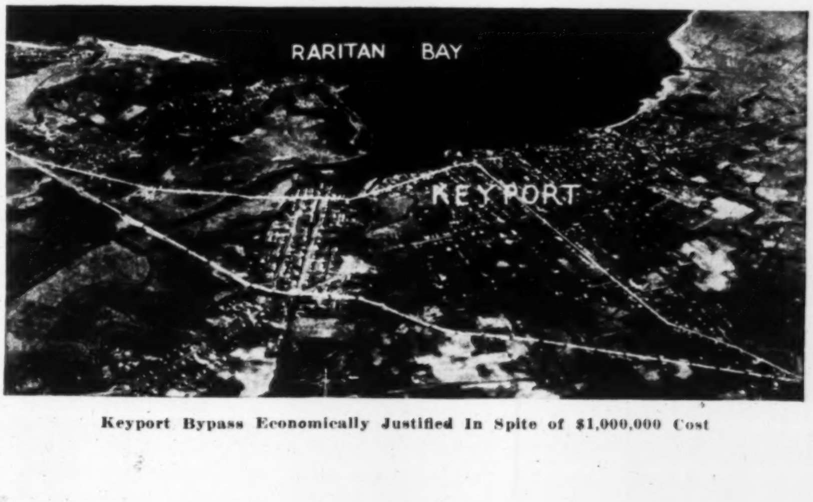
Hammonton Bypass—The bypass at Hammonton was built ten years ago when traffic, although heavy for that day, did not compare with that of today when 40,000 vehicles are recorded on several days in the summer season. The business section and two right-angle turns were avoided. The distance saved was three-fifths of a mile, so that it may be said that 24,000 car-miles is saved on some days. Assuming an operating cost of 5c. per mile and of $3 per hour would give a saving on such a day of $3,600 to the traveling public, or possibly $270,000 per year on a total estimated traffic of 3,000,000 vehicles.

While it is realized that the above assumption may be open to argument as being either too radical or too conservative, it is still clear that the construction of the bypass was justified on economic grounds, since it involved the construction of but 2½ miles of road of no unusual difficulties at an expenditure less than the cost of widening and paving the old alignment. It has been contended that the bypass has paid for itself each year since its construction. Without going into the reasonableness of assumptions of the economic benefits, it is certainly true that this bypass has moved the seashore nearer the large center of population in and around Philadelphia and Camden, and has done much to increase the safety and convenience of the motorist as well as the profits of the seashore resorts which it serves.

Keyport Bypass—One of the most annoying and dangerous obstacles to travel by the seashore route from the New York-Jersey City-Newark metropolitan area to the northern coast resorts of New Jersey was removed by the Keyport bypass. Keyport has a population of about 5,000. The old route through the borough passed over narrow streets and a busy grade crossing, involving an additional distance of about ⅕ mile and many minutes of time. On busy days a delay of two hours was not unusual. Traffic counts have recorded 47,529 vehicles per day. Although the construction cost of the bypass was about $1,000,000 for 2.6 miles, involving a drawbridge, a railroad bridge and the crossing of a swamp with a depth of mud up to 80 ft., it is felt that the expenditure was well worth while, considering the advantages accruing to an estimated traffic of 5,000,000 cars yearly.

Bordentown Bypass—The Bordentown bypass serves two state routes. By reason of considerable interchange of traffic from one route to the other there are four distinct traffic flows using the bypass. The length of travel for one of these is about the same as by the old route, but for the others it has been materially decreased. Besides the decrease in distance and improvement in alignment and width, the construction of this bypass has relieved the motorists using these routes from crossing the trolley tracks eight times.

Dover and Rockway Bypasses—The Dover and Rockaway bypasses, while planned separately and constructed at different times, join at the point where each joins the old route. Both the old and the new route twice crossed the Rockaway River, the Central Railroad of New Jersey, the D. L. & W. R. R. and the old Morris Canal within a



Keyport Bypass Economically Justified In Spite of $1,000,000 Cost

distance of 4 miles. The new route was rather expensive to construct, involving a viaduct 900 ft. long, costing $250,000 on the Rockaway bypass, and on the westerly end of the Dover bypass bridges over westbound local traffic from Dover, the river, two railroads and one of the important streets of the town. The construction cost was $500,000 for a distance of 3,100 ft.

General Summary—For the bypasses described and for all the others, the maps show the bypass road and the old road so that the comparative alignments and distances can be judged. Although the maps indicate a general similarity in all these bypasses, they actually vary greatly in length and degree of improvement compared with former conditions, and they vary in cost. There is also considerable variation in the traffic using them and the population and traffic bypassed. The problems of location and design were not essentially different from those on any section of highway over new right-of-way.

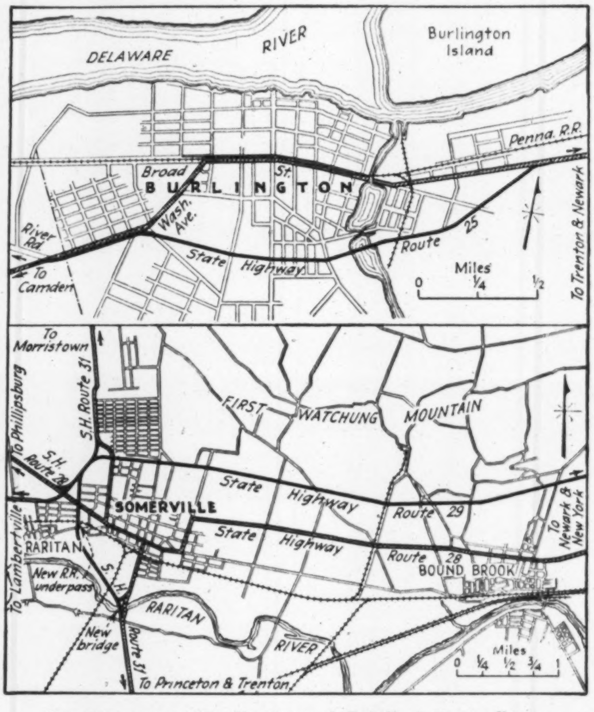
The attitude of the local residents and business men toward proposals to bypass is diverse. At first there was much opposition, but as the benefits became apparent there has been a reversal of sentiment in favor of bypasses. At present a proposal to build an important state highway through the center of the business or residential section is vigorously opposed. While at first it seemed that the advantages of the bypass were all on the side of through traffic, it now becomes apparent that the principal advantage is to the community bypassed. This has come about by the large increase in traffic, the increase in speed and the realization that the motorist spends little money on his way.

The second group of bypasses show routes where the centers of population are so close that it was found to be impracticable to utilize the existing routes with individual bypasses. It may be noted that these bypass routes practically parallel existing through routes which pass through the centers of population.

The same reasons required the construction of these routes and the problems were the same as to magnitude as where single towns have been detoured. They may be said to be the smaller bypasses grown up to meet more modern requirements. It should be noted that the improvement of these routes came after the improvement of the existing routes in the vicinity, and which have become inadequate to meet the traffic needs.

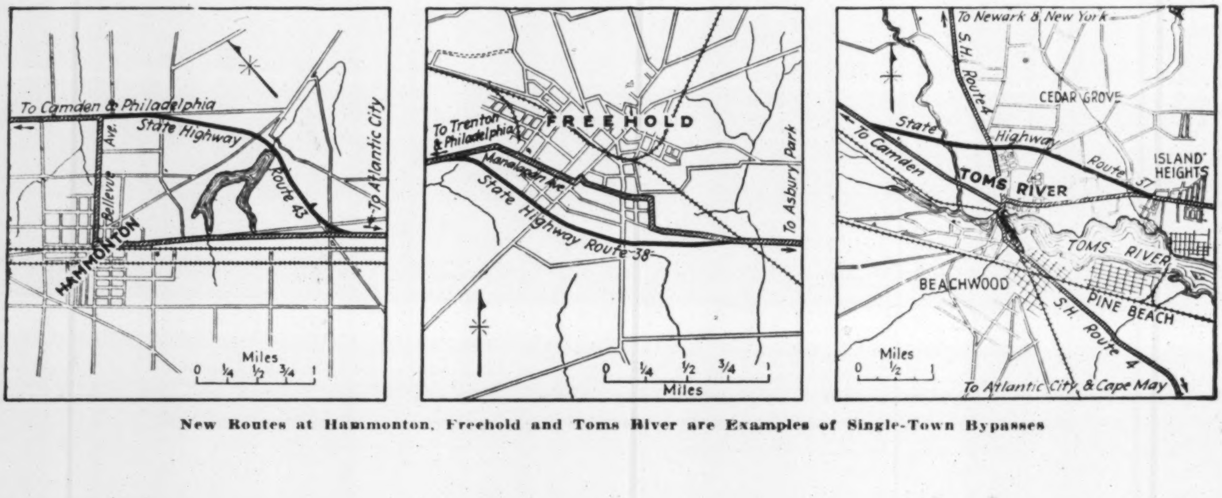
Eatontown-Belmar Bypass—At the intersection of route 33 and old route 4 near Asbury Park, on Labor Day, 1928, a traffic count showed 47,000 vehicles. Much of this was local traffic from a summer population in this vicinity of about 300,000. The old route running north and south through the seashore resorts was so congested that both local and through traffic was very much annoyed. A bypass route 35, 9 miles long was constructed from Eatontown to Belmar, both points on the old route. This route lay inland from the shore towns. On Labor Day, 1929, a traffic count at the point which a year before showed 47,000 vehicles then showed about 35,000, but the new route showed a traffic of 20,000, these counts indicating the yearly increase of total traffic.

Raritan-Newark Bypass—Somewhat similar to this, except that it illustrated a normal rather than seasonal condition, was that between Raritan and Newark. Route 28 from Elizabeth to Phillipsburg has been constructed as the main road through the towns. Passing through a population of 250,000 spread out over a distance of 25 miles, traffic seriously inconvenienced local business.



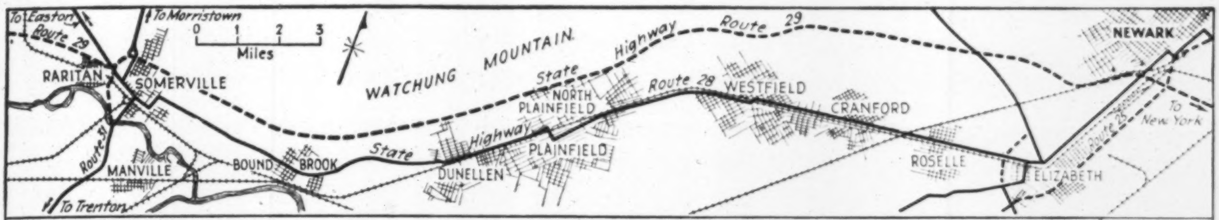
DELAWARE RIVER
Burlington Island
Penna. R.R.
Broad St.
BURLINGTON
Wash. Ave.
River Rd.
To Camden
State Highway
Route 25
Miles
0 1/4 1/2
To Trenton & Newark
To Morristown
S.H. Route 31
To Phillipsburg
S.H. Route 28
FIRST WATCHUNG MOUNTAIN
State Highway Route 29
SOMERVILLE
To Lambertville
RARITAN
State Highway Route 28
To Newark & New York
BOUND BROOK
New R.R. underpass
S.H.
RARITAN RIVER
New bridge
Route 31
To Princeton & Trenton
Miles
0 1/4 1/2 3/4 1

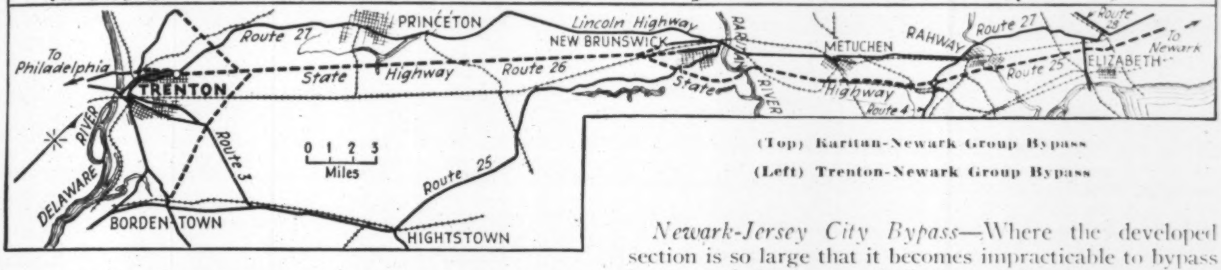
Local Bypass at Burlington and Detail of Group Bypass at Somerville



To Camden & Philadelphia
State Highway
Bellevue Ave.
Route 43
To Atlantic City
HAMMONTON
Miles
0 1/4 1/2 3/4 1
To Trenton & Philadelphia
FREEHOLD
Manalapan Ave.
State Highway Route 38
To Asbury Park
0 1/4 1/2 3/4 1
Miles
To Newark & New York
S.H. Route 4
CEDAR GROVE
To Camden
State Highway Route 37
ISLAND HEIGHTS
TOMS RIVER
TOMS RIVER
BEACHWOOD
PINE BEACH
S.H. Route 4
Miles
0 1/2
To Atlantic City & Cape May

New Routes at Hammonton, Freehold and Toms River are Examples of Single-Town Bypasses

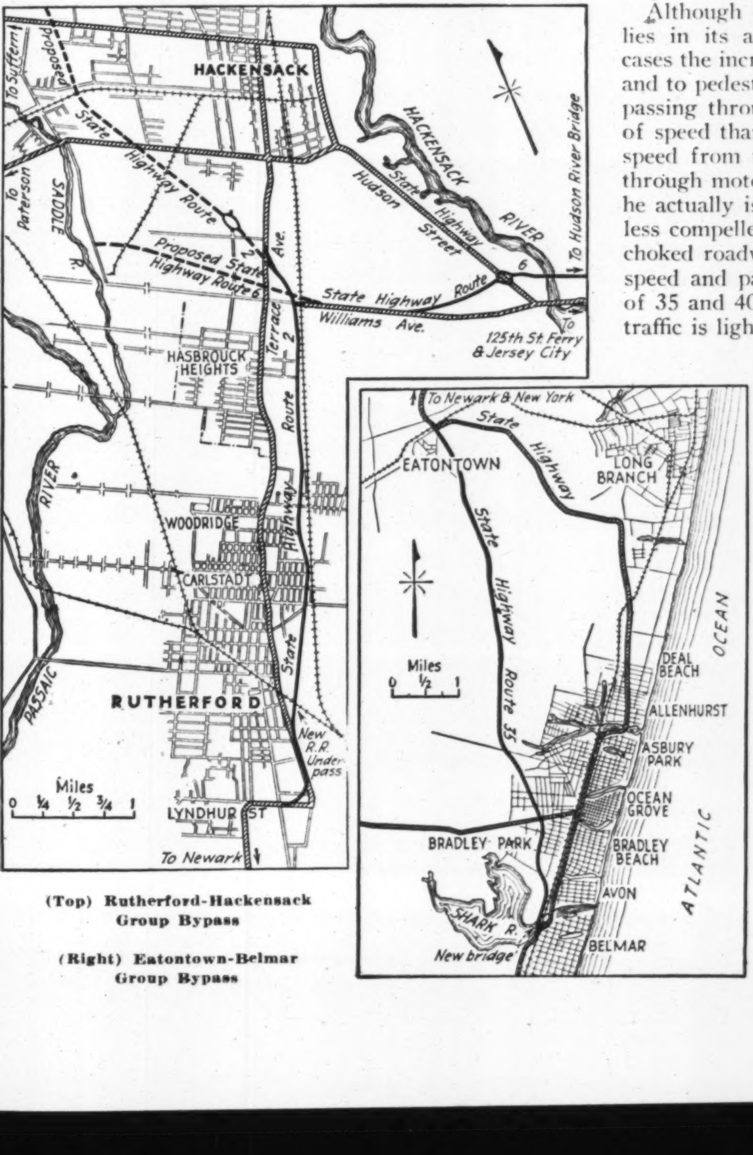

To Easton
Route 29
To Morristown
0 1 2 3
Miles
RARITAN
SOMERVILLE
WATCHUNG MOUNTAIN
State Highway Route 29
NEWARK
Route 51
MANVILLE
BOUND BROOK
State Highway
NORTH PLAINFIELD
PLAINFIELD
DUNELLEN
Route 28
WESTFIELD
CRANFORD
ROSELLE
ELIZABETH
Route 25
To New York
To Trenton


To Philadelphia
TRENTON
Route 27
PRINCETON
Lincoln Highway
NEW BRUNSWICK
RARITAN RIVER
METUCHEN
RAHWAY
Route 27
Route 25
ELIZABETH
To Newark
State Highway Route 26
State Highway
Route 4
DELAWARE RIVER
Route 3
0 1 2 3
Miles
Route 25
BORDENTOWN
HIGHTSTOWN

(Top) Raritan-Newark Group Bypass

(Left) Trenton-Newark Group Bypass

Route 29 was projected and is now being built practically parallel and to the north of route 28, bypassing the business district and centers of population of Raritan, Somerville, Bound Brook, Middlesex, Dunellen, Plainfield, North Plainfield, Fanwood, Scotch Plains, Westfield, Garwood, Cranford, Roselle Park, Elizabeth, Union and Hillside, joining the Newark bypass, route 25, the superhighway from the Holland Tunnel.


To Suffern
Proposed
HACKENSACK
State Highway Route 2
To Paterson
SADDLE R.
HACKENSACK RIVER
Hudson Street
State Highway 6
To Hudson River Bridge
Proposed State Highway Route 6
State Highway Route 6
Williams Ave.
To 125th St. Ferry & Jersey City
Terrace Ave.
Route 2
HASBROUCK HEIGHTS
PASSAIC RIVER
WOODRIDGE
State Highway
CARLSTADT
RUTHERFORD
New R.R. Underpass
Miles
0 1/4 1/2 3/4 1
LYNDHURST
To Newark
To Newark & New York
State Highway
EATONTOWN
LONG BRANCH
State Highway Route 35
Miles
0 1/2 1
DEAL BEACH
OCEAN
ALLENHURST
ASBURY PARK
OCEAN GROVE
BRADLEY PARK
BRADLEY BEACH
ATLANTIC
AVON
SHARK R.
New bridge
BELMAR

(Top) Rutherford-Hackensack Group Bypass

(Right) Eatontown-Belmar Group Bypass

Newark-Jersey City Bypass—Where the developed section is so large that it becomes impracticable to bypass because of the increased distance, it has been necessary to construct double level roadways. Route 25 from the Holland Tunnel in Jersey City to Camden has been constructed as a depressed roadway part of the way and elevated roadway in part, coming to grade in the Newark meadows of the developed section of the city. Route 21 is planned as an elevated road for about 3 miles through the developed section of the city of Newark. Such routes may be termed vertical bypasses.

Although the greatest value of the highway bypass lies in its ability to expedite through traffic, in most cases the increased safety to both through and local traffic and to pedestrians is considerable. Through traffic while passing through a town tends to maintain a higher rate of speed than that of local traffic. A slight decrease of speed from that maintained on the open road, gives the through motorist a feeling of traveling more slowly than he actually is, and hence a false sense of security. Unless compelled to stop by effective traffic regulation or a choked roadway, through traffic will attempt to maintain speed and pass the slowly moving local traffic. Speeds of 35 and 40 miles per hour through small towns where traffic is light are not unusual.

This condition is a hazard to pedestrian and local traffic. Fast moving vehicles cause confusion and uncertainty in the minds of pedestrians and slow drivers. There is also a nervous tension under these conditions, and the confusion and nervousness are in themselves the cause of many accidents. The separation of the through traffic from the local traffic allows both to be unhampered and makes for easier and freer movements with greater safety.

In addition, increased width of roadway, elimination of sharp turns, steep grades and trolley crossings, conditions which could not be obtained on the existing alignment without prohibitive cost, are obtained on the new alignment of the bypass. The engineer is permitted to design for safety as well as for utility by removing the through highway from the city street. Thus, by removing dangerous conditions and separating different types of traffic by means of the bypass, increased safety is brought to our highways and city streets regardless of the tendency toward ever-increasing speeds.

Safety and Speed on Detours

By V. R. Burton
Deputy State Highway Commissioner, Lansing, Mich.

Current Practice Makes a Modern Bypass a "Temporary Route" Instead of the Slow, Unsafe Road Formerly Pictured as a "Detour"

Much of the prejudice against detour routes exists because of the word "detour" and what it means to the motorist. This prejudice, while almost wholly psychological at present, is admitted to have had a distinctly physical basis not so long back. The first step in robbing the detour of its terror in Michigan was to forbid the general use of the word. The trunk highway marking is now moved bodily over onto the bypass road and it is known as a "temporary route," and is so shown on highway maps. Detour maps are not issued and the word itself is used only in places where the change in route is very short or in cases where the time of traffic interruption on the main line is only a few days.

The adoption of this method of handling traffic around construction, however, entails much greater responsibility in providing a quality of highway service that will justify its use. It is no longer possible to turn traffic into an unimproved road, mark it "Detour," and let a long-suffering public struggle through as best it can. If improved roads are not available as a reasonably direct bypass where traffic is of any consequence at all, either a certain amount of construction must be carried out on a bypass route or traffic must be carried through the job.

By the construction of a bypass route it is not meant that a high-class road of intermediate type is necessary, but it is pretty generally accepted that sufficient work must be done to carry the traffic using the road not only conveniently and safely but comfortably as well. It is surprising how much a little grader work, a thin layer of stone or gravel and a liberal use of dust layer will do to take the traffic through the construction season. The cost of the work is not great and will usually run less than the annual charge for interest and maintenance on the higher-type road under construction around which it leads.

The use of a bypass is nearly always preferable to taking traffic through the job. This is especially true for routes on which heavy grading is necessary, although in sparsely settled territory where the topographical features prevent relocation passing through is sometimes unavoidable. Even here a little thought in planning construction operations and the thorough co-operation of the contractors in their execution, will result in a much improved highway service. Widening operations should always take place so far as possible before the old roadway is touched. With the width of shoulder necessary to modern grade design, it will then be possible to carry traffic through on half the road while the other half is brought to grade. Where work is heavy it may be necessary to accomplish the approach to grade with several lifts and consequent shifts in traffic from one side to the other. A little race on the dump and the frequent use of a heavy grader will help in placing the material as well as in providing a passable riding surface for traffic.

When traffic must be carried, through a job on which a two-lane pavement is being built, a frequent practice is to build one-half at a time. This practice should be thoroughly discouraged for long jobs, unless it is possible to maintain traffic beside the slab in both directions.

Congestion about the mixer occasioned by men, materials and equipment cannot be avoided, and with the best of traffic control, delays to traffic are frequent and annoying. After the first slab is down long enough so that it can be used, the contractor should be required to go back and bring the second slab up to the end of the first. No more half-slab should be permitted than is absolutely necessary. Leaving out of consideration the delays to traffic and the possibility for accident, it is very difficult to keep traffic off of the newly laid second slab.

Where the topography will permit, it will in many instances be as cheap and much more satisfactory to depart from the old location altogether. From the standpoint of traffic this is by far the best solution of the detour difficulty. Usually the old route is indirect enough so that it can be intersected at points not farther distant than a good season's job and still maintain a much more direct route than the old. Traffic need never know that anything out of the ordinary is going on until the new road is thrown open to travel.

This does not involve the waste which the ordinary layman might think, although supposedly vested rights in the old location frequently arouse serious opposition to the general adoption of this policy. There is very frequently little salvage value on the old road, in fact, money can often be saved by leaving it. Aside from distance which can be shortened, the detail alignment of the old road is usually wholly unsatisfactory for modern speeds. Grade changes cannot be made economically or without serious property damage, and the right-of-way is lined with structures which are either in the way of construction or within the new right-of-way width necessary to modern highway design. Drainage structures are nearly all too narrow and most of them too weak, so that rebuilding of many and the lengthening of all are necessary. In addition to no practical difference or a positive saving in construction funds, there is always the advantage of saving the old road for local use or as a temporary route in the event of an emergency closing of the new.

In planning construction of highways where the pavement width is four lanes or more, it is much easier to carry traffic through than on two-lane construction. Where the boulevard type is used with separate slabs and a party strip between, it is simply necessary to construct the new side first and, when built, to carry traffic on it while reconstructing the old. Right-of-way costs are often found to be cheaper in planning construction by this method, since it involves taking most or all of the extra width off one side, without any or only slight damage to the other. Where an existing two-lane pavement is to be widened to one or two lanes more alongside the old, the problem is not so much one of traffic safety as it is one of providing safety to workmen from traffic. Where traffic is heavy it is usual to keep the pavement side of the new slab clear of equipment and materials and carry on all the operations possible on the outside. The use of industrial railway simplifies the traffic problem considerably in these cases.

One of the most effective means of eliminating many of the troubles incident to handling traffic through or around construction is to have construction proceed only during those months in which it is possible to handle traffic over comparatively lightly built roads. This means that contracts must be let early enough for the construction forces to be well organized as soon as the season opens, and that the length of the job should be so planned that it is possible to complete the work early enough in the fall for traffic to use the new road before the maintenance of the temporary route becomes difficult in wet weather.

SAFETY, comfort and facilities for reasonable speed are necessary on modern bypass routes.

LENGTHS of half-slab pavement to be traversed where passing through is neecssary should be kept at a minimum.

AVOIDING both detours and passing through by relocation is not as costly as it is generally supposed to be.

DETOUR points need to be clearly indicated by conspicuous barricades and by flares at night.

Detour Period Reduced by Planning

Contracts should be let in the late fall or early winter in order to permit plenty of time to get the job organized before the season starts, and to do a certain amount of preparatory construction work during the fall and winter. While there is some opposition to this policy from uninformed sources because of the theoretical deficit in funds created by incurring obligations in advance of the collection of sufficient revenue to discharge them, there is little justification for it.

There is so little work possible between November and May in our northern states that usually ample funds are available to pay estimates as earned, if some discretion is used in awarding the jobs. Work which can be done, however, is so important in its effect on progress during the regular construction season that early lettings are being held in most of those states in which the law will permit this practice Culverts which would hold up construction are installed during the winter, and heavy fills are placed wherever possible. Clearing and grubbing can be done much more easily during the winter, especially if much of this work must be done in swampy territory. The effort to relieve the unemployment situation by planning for winter work has shown by actual cost figures that many things can be done for which no cost premium need be paid.

On the other hand, there are certain types of construction which in Michigan are usually handled by the maintenance department, and these are particularly objectionable once the heavy summer traffic has started. This is particularly true of construction which involves the use of a bituminous material over the road surface which is expected to carry traffic. In this case every effort should be made to see that the work is done as early as possible in the spring before the traffic peak is reached. It will in this case be found advisable many times, if suitable bypass routes are available, to bypass traffic during the short period necessary while the bituminous material is setting up. Much of the prejudice against this very useful construction material has arisen through lack of care in planning the handling of traffic during the time when the oil is soft enough to pick up under motor traffic.

Special Cements Speed Up Repairs

In general, the use of high-early-strength cements to cut down the construction period is confined to maintenance operations, constructions of intersections or to short pieces of construction on heavily traveled routes where the difference in time involved in the setting up of the slab is an important factor. This material is particularly valuable for patching operations or at intersections, as it has been found perfectly safe to open the road in about 48 hours during ordinary construction weather. In patching operations particularly, the additional cost of the cement is not a factor because of the fact that usually the price of mixing and placing is considerably higher than it would be on the regular construction job, so that proportionately the percentage of cost of the cement is greatly reduced.

With standard portland cements attaining a strength sufficient to open the pavement in from seven to ten days, as determined by actual field tests in using cast beams as a method of control, it is difficult to see how the use of this special cement has any particular function in the ordinary construction job. There are so many other details of construction unfinished by the time the slab is laid that the added time gained by its use is comparatively unimportant. This, of course, applies particularly to those projects in rural territory in which access to the main route is more or less infrequent, being at about a mile or one-half mile intervals.

Adequate Barricades Needed

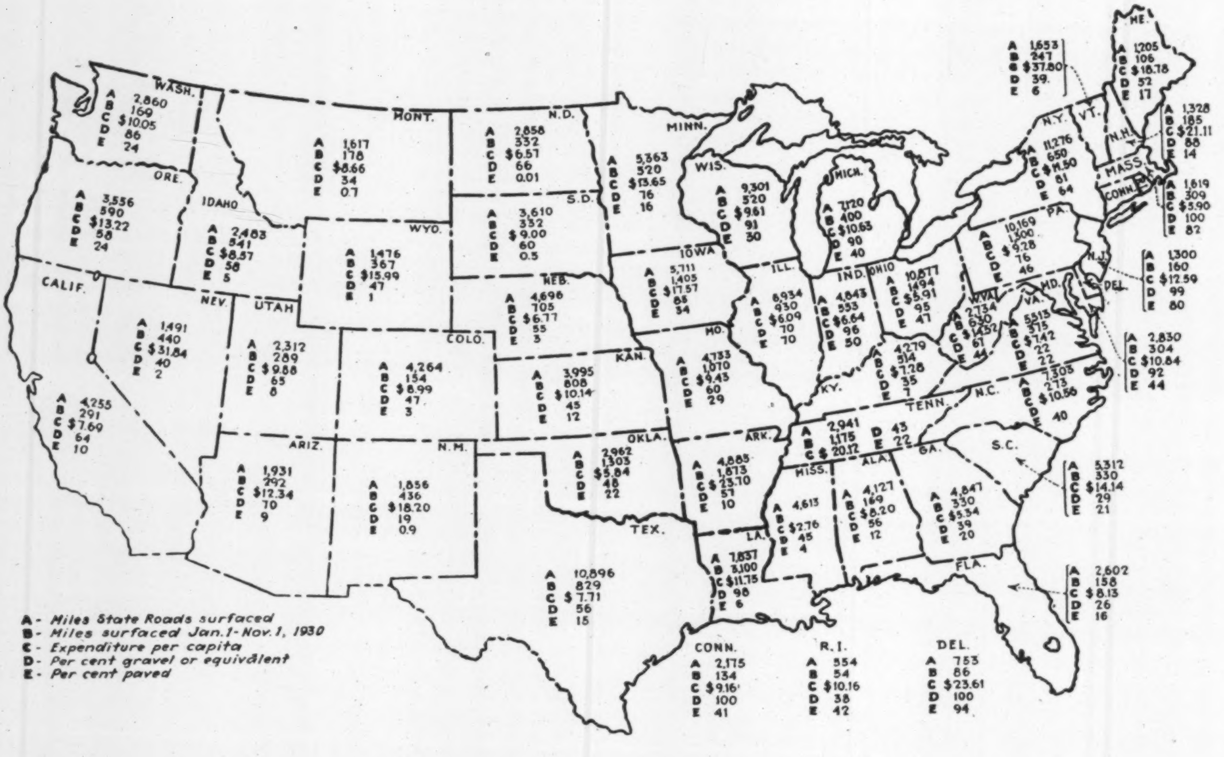
Much better methods of protection both for traffic and for the work under construction have been devised during the past few years. A very effective barricade has been devised by the use of the standard snow fence of the wire and picket type, as a barrier at the end of the road and also along and around short pieces of slab construction or concrete patches. This snow fence has in Michigan been painted a federal yellow so that it is easily visible either in the daytime or under the headlights of a motor vehicle at night. It has the additional advantage of presenting little resistance to impact when accidentally struck by an automobile, and still serves as a warning that further travel along the road is dangerous.

In addition to the use of the snow fence barricade, illuminated signs of the reflector-button type are placed in advance of the time at which the barricade will be met, sufficiently distant so that the driver can bring his car under control in order to turn off the road. Besides this, kerosene flares are placed directly in front of the barricades.

The bomb type of kerosene flare has contributed greatly to the protection of both traffic and construction work since its nearly universal adoption. Where widening of slabs is in progress and traffic is using a part of the road, it has been found sufficient to line the edge of the new slab with kerosene flares and with occasional horses to afford nearly complete protection. In the last few years the general public has been pretty thoroughly educated to the fact that the flares appearing along the road are a danger warning and one which should be, and is, thoroughly respected.

Finally and above all, the protection of traffic and the maintenance of protection devices, as well as of the bypass road itself, should be the responsibilities of a single organization. In Michigan the entire responsibility for the protection of traffic around construction jobs of any magnitude is placed squarely on the shoulders of the maintenance department. Years ago contracts provided that not only barricades barring traffic from construction but also maintenance of detour roads were the responsibility of the contractor. It was during this period that much of the justifiable prejudice of the traveler arose against anything called a detour. In the past few years complaints as to the condition of our temporary routes are no more frequent than those coming in from main routes of the same general type. The realization by highway authorities that construction work on the main line means an increased effort to provide the sort of highway service on the bypass demanded by the present-day traveler, instead of providing an excuse for a poor road, has done much to justify the contention that the days of "detour" are or should be over.

Distribution of Total Mileage of Surfaced Road in State Highway Systems


WASH. A 2,860 B 169 C $10.05 D 86 E 24
ORE. A 3,556 B 590 C $13.22 D 58 E 24
CALIF. A 4,255 B 291 C $7.69 D 64 E 10
IDAHO A 2,483 B 541 C $8.57 D 58 E 5
NEV. A 1,491 B 440 C $31.84 D 40 E 2
MONT. A 1,617 B 178 C $8.66 D 34 E 0.7
WYO. A 1,476 B 367 C $15.99 D 47 E 1
UTAH A 2,312 B 289 C $9.88 D 65 E 8
COLO. A 4,264 B 154 C $8.99 D 47 E 3
ARIZ. A 1,931 B 292 C $12.34 D 70 E 9
N.M. A 1,856 B 436 C $18.20 D 19 E 0.9
N.D. A 2,858 B 332 C $6.57 D 66 E 0.01
S.D. A 3,610 B 332 C $9.00 D 60 E 0.5
NEB. A 4,696 B 705 C $6.77 D 55 E 3
KAN. A 3,995 B 808 C $10.14 D 45 E 12
OKLA. A 2,962 B 1,303 C $5.84 D 48 E 22
TEX. A 10,896 B 829 C $7.71 D 56 E 15
MINN. A 5,363 B 520 C $13.65 D 76 E 16
IOWA A 5,711 B 1,405 C $17.57 D 88 E 34
MO. A 4,733 B 1,070 C $9.43 D 60 E 29
ARK. A 4,885 B 1,873 C $23.10 D 57 E 10
LA. A 7,837 B 3,100 C $11.75 D 98 E 6
WIS. A 9,301 B 520 C $9.61 D 91 E 30
ILL. A 8,934 B 930 C $6.09 D 70 E 70
MICH. A 7,120 B 400 C $10.63 D 90 E 40
IND. A 4,843 B 553 C $6.64 D 96 E 50
OHIO A 10,877 B 1494 C $5.91 D 95 E 47
KY. A 4,279 B 514 C $7.28 D 35 E 7
TENN. A 2,941 B 1,175 C $20.12 D 43 E 22
MISS. A 4,613 B C $2.76 D 45 E 4
ALA. A 4,127 B 169 C $8.20 D 56 E 12
GA. A 4,847 B 330 C $5.34 D 39 E 20
FLA. A 2,602 B 158 C $8.13 D 26 E 16
S.C. A 5,312 B 330 C $14.14 D 29 E 21
N.C. A 7,303 B 273 C $10.56 D E 40
VA. A 5,513 B 375 C $7.42 D 22 E 22
W.VA. A 2,734 B 630 C $14.52 D 61 E 44
MD. A 2,830 B 304 C $10.84 D 92 E 44
PA. A 10,169 B 1,300 C $9.28 D 76 E 46
N.J. A 1,300 B 160 C $12.59 D 99 E 80
N.Y. A 11,276 B 650 C $11.50 D 81 E 64
VT. A 1,653 B 247 C $37.80 D 39. E 6
N.H. A 1,328 B 185 C $21.11 D 88 E 14
ME. A 1,205 B 106 C $18.78 D 52 E 17
MASS. A 1,619 B 309 C $5.90 D 100 E 82
CONN. A 2,175 B 134 C $9.16 D 100 E 41
R.I. A 554 B 54 C $10.16 D 38 E 42
DEL. A 753 B 86 C $23.61 D 100 E 94
A - Miles State Roads surfaced
B - Miles surfaced Jan. 1-Nov. 1, 1930
C - Expenditure per capita
D - Per cent gravel or equivalent
E - Per cent paved

ALL figures in the above map refer to state highway systems only. Total number of miles of road surfaced and the amount surfaced during first ten months of 1930 are shown. Figures for expenditure per capita are based upon the amount each state spent on its highway system during the last full year. Vermont leads with per capita expenditure of $37.80; Nevada is next with an expenditure of $31.84. Several states spent over $20 per capita in one year on state highways. Mississippi spent the least per capita, $2.76. Percentages of pavement and other types of surfacing shown in the map are totals from the last complete reports. Three states, Massachusetts, Delaware and Connecticut, have their state systems 100 per cent surfaced. Other states leading in these figures are: New Jersey, 99 per cent; Louisiana 98 per cent; Indiana, 96 per cent, and Ohio, 95 per cent. New Mexico, with 19 per cent of its state system surfaced, trails the list. An average of 62 per cent of all state highways was surfaced with gravel or better material on Jan. 1, 1930. Of a total of 3,024,233 miles of road of all classes in the country, 662,435, or 23 per cent, are surfaced with some kind of material. Indiana leads with 69 per cent of all roads surfaced: Ohio is next with 52 per cent. Construction on all state highway systems for the first ten months of 1930 amounted to the following mileages: paved surface, 1,203; low-type surfacing, 15,763; graded and drained, 9,951. This is an increase of 5,715 miles over 1929.

Road Signs, Route Marking and Signals as Safety Appliances

Review of General Principles, Progress in Standardization, Form and Color, Night Signals, Also of Progress Made in Roadway Marking and Route Signs and Warning Signals

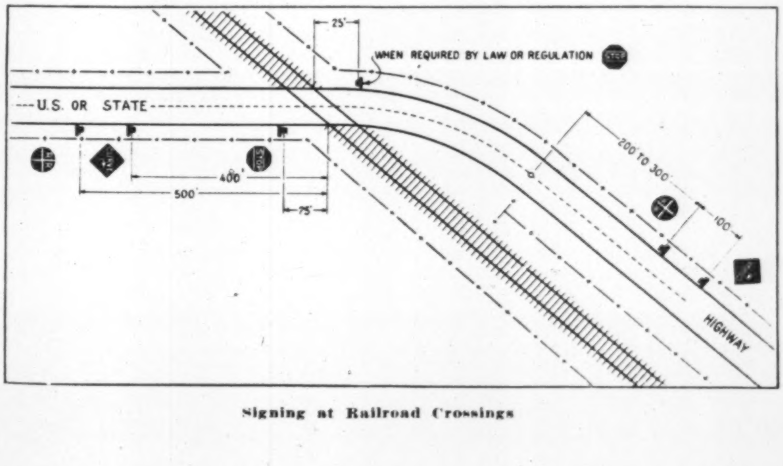
By E. W. James

Chief Division of Highway Transport, Bureau of Public Roads, Washington, D. C.

NEGLECT of the element of safety continues to be the greatest defect in utilization of highways. In round numbers, 30,000 deaths were attributable to highway accidents during the calendar year 1930. Probably no single remedy can be found to correct the condition, but there will continue to be a series of palliatives, each intended to meet a specific dangerous feature.

Superelevation of curves will prevent cars running at limited speeds from leaving the road. Guard rails will furnish needed lines of visibility marking dangerous slopes and the course of the road; other specially constructed rail may prevent some cars from plunging off the grade. Lengthened radii and longer sight distances will do something toward reducing collisions on curves. Wider travel lanes will prevent accidents due to loss of control when running off the edge of the surface at high speed, and lip curbs tend to keep traffic on the road. Ordinary rules of the road will do much to make safer driving possible, by keeping traffic where it belongs and by allotting more or less consistent rights to drivers at intersections, curves, hill crests and other points of special danger. But none of these is sufficient to accomplish its intended effect unless observed within the limits to which the particular palliative applies.

To remind the driver of his responsibility, to inform him of changing conditions in the road and to indicate to some extent the degree of caution necessary in a particular situation is the function of the road sign or signal.



Signing at Railroad Crossings

Visibility, uniformity and simplicity are the indispensable requirements of any system of road signing for safety purposes. The system of signs proposed by the American Association of State Highway Officials and very widely adopted by the states possesses these characteristics. Studies made by several agencies, including the U. S. Bureau of Standards, the University of Illinois and the laboratory of psychology at Johns Hopkins University, indicate that a black design on a canary-yellow background has highest visibility in daylight under the greatest variety of conditions. Certain photographic tests appear to indicate that black on white or white on black has greater visibility, but this apparently favorable quality is limited to certain conditions of light and background, and at Johns Hopkins it was shown that human reactions are quicker in noting the tinted than the white or the black sign.

The height and position of the sign along the roadside has a practical relation to visibility, and these details have been carefully worked out and are given in the manual of signs of the American Association of State Highway Officials. On rural roads the location of the signs must recognize the requirements of economic maintenance, including removal of snow, as well as the range and legal adjustment of headlights. In cities the parking regulations affect the location.

The general scheme of designs is, of course, uniform and extremely simple. The circular disk already generally adopted by the American Railway Engineering Association was also adopted by the highway officials' organization for the sole purpose of denoting a railroad crossing. Three caution signs were adopted denoting progressive requirements in the way of caution. The first is a square sign indicating an intermittent condition or one existing outside of the road itself requiring care and attention on the part of the driver. It means that the driver should at least take his foot off the accelerator. The second degree of caution is a square sign with one diagonal set vertical giving the effect of a diamond shape and warns the driver of some feature existing in the road itself requiring that the car be at once brought under complete control. It means at least that the driver should put his foot on the brake. Examples of the square sign are those for school zones, hospital zones, and crossroads. The variety of diamond signs is much larger, including those for curves, turns, hills, narrow bridges and other similar conditions requiring unusual care on the part of the driver.

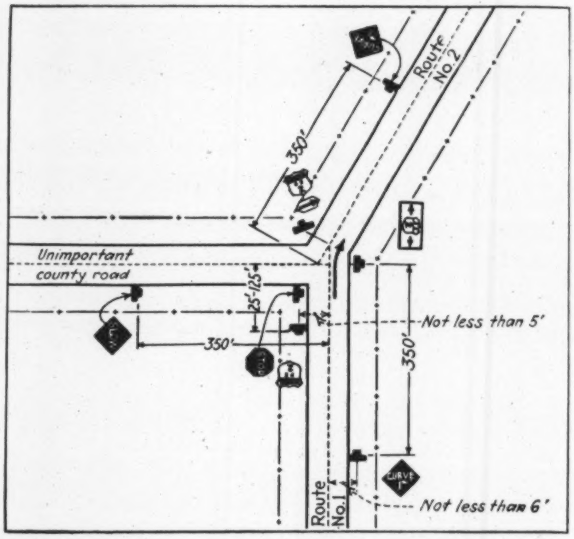
The final degree of caution is designated by an octagonal sign meaning stop—and then proceed with caution.

All the caution signs have black legends on canary yellow backgrounds. The design consists usually of a single word or two having in some cases a symbol of clear and unmistakable signification.

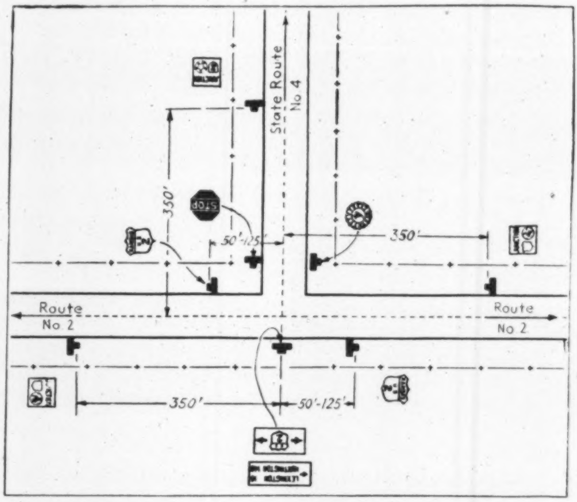
The continental system of highway signs in blue and white adopted at the International Diplomatic Conference on Automobile Circulation in Paris in 1926 uses no words in the designs and depends entirely on symbols. This scheme was undoubtedly adopted because of the international character of the conference; and the result is a system that is severely limited in the variety of purposes for which signs can be simply devised. The American system has now been put into Spanish and Portuguese, using words of those languages and of course the same shapes and color scheme as the American signs. No difficulty was experienced in thus adopting the highway officials' sign manual for use in the principal language countries of the Western Hemisphere.

Considerable thought and study were given to the legends in the American signs, and also to the use of symbols. The final decision was to use occasional symbols of a very simple form. It was considered safer, for instance, when designating a curve to indicate the direction of the curve than to leave the driver in doubt. More complete information was believed to be more conducive to safety than less information.

The difference in the continental and American systems was brought again to the fore at the recent International Road Congress in Washington, and a conclusion was adopted by the Congress that the Permanent Secretariat of Road Congresses appoint a committee to consider the possibility of harmonizing, combining or unifying the two systems. Whether this can be done in any satisfactory degree may well be doubted, because the contiental system has no other underlying scheme of signification than that embodied in a set of symbols, some of which would be without meaning to Americans. A St. Andrew's cross, or "sawbuck," means to us, if it means anything when on a sign, a railroad grade crossing. In the continental system it means a crossroad. A section of fence or picket gate on the continental signs indicates a protected railroad crossing requiring a stop. If seen on a road sign it certainly would have no significance to an American unless he were specially instructed. The continental signs have the merit of simplicity, but the connotation or suggested meaning of the symbols is not clear to Americans. Moreover, our road conditions requiring warning signs are so numerous that we should soon run out of symbols in trying to extend the continental system to meet our needs. It would be a fine thing if a truly universal, international system could be devised. It would have to the greatest possible extent the desired characteristic of uniformity. But, after all, it is not so important that the continental and American systems be harmonized, because there is no possibility of continuity in the two highway systems on which the respective signs will be used. Uniformity in any one continent is very desirable.



Marking at intersection of U. S. or state route with local road showing octagonal sign for greatest caution and diamond shaped signs for caution



State route intersecting federal route showing states signs and guide sign with distances to important cities

Heretofore little effort has been made to standardize signs especially adapted for night service. When the existing standard code of signs was devised the manufacture of reflecting, automatic and illuminated signs was just beginning to assume commercial importance, and the variety of form and uncertainty of effect led to the deliberate exclusion of all signs of this character. Since 1924 the development of signs suited to use at night has been notable and some devices have been perfected that were then unknown. It is now timely that full and careful consideration be given to adapting the entire scheme of road signs to night use. This will not be a simple matter. Conditions of visibility to be met are altogether changed and the materials of construction are much less flexible. Adaptation of the present system for night service may require changes in color code, in the standardized alphabets and in some cases in the design itself. No fundamental changes will be required, however, affecting the shape, principal color significance or general purpose of the several designs. The use of symbols may be more convenient than words on some signs and a combination of symbols and words may be abandoned in some cases. Harmonizing the continental and American signs becomes unfortunately more rather than less difficult when night signs are considered.

Elimination of Unnecessary Signs

In application the use and effectiveness of road signs demand, for the sake of safety, that other signs be removed from the highways. Except those signs required and reasonably placed to serve a specific purpose in the interest of the traveler, no other signs are needed along any road. No advertising along our highways is necessary anywhere. The traveler should be informed, cautioned or definitely admonished as the situation may require. If he can depend on these directions always, the effectiveness of the signs as guideposts to safety will be greatly enhanced. The good sense, consistency and exactness with which the signs are used will increase respect for them. The driver who is led to think to himself only once that he wishes he had followed that last sign instruction begins to cultivate a healthy regard for signs well placed.

Progress and Education

Large sums have been expended in signing our principal highways by state and by some county authorities. This condition tends to crystallize the existing standards. No changes should be made that are not absolutely necessary to increase the effectiveness and safety value of the system. But there is still a large replacement annually of damaged, deteriorated or misplaced signs and if minor changes appear to be needed they can be introduced over a period of two or three years without requiring more than ordinary replacement costs.

Active agencies are still at work to improve, extend and perfect the scope of road signing. The distantly esthetic feature is being considered. The reduction of number is always urged. The total elimination of all other distracting signs, unofficial in character, is a principle agreed upon and awaiting only complete legal authority to become a fact. The part in promoting the safer use of our highways that may be played by proper signing is not overrated, is founded on sound premises and can be fully accomplished by a consistent and exact use of the system now generally in vogue. Strange as it may appear, some educational work must still be done to inform the public regarding the significance of road signs. Such educational work is now being planned.

The distribution of the manual adopted by the American Association of State Highway Officials has resulted in a wide and consistent use by the state highway departments of the principles involved. For the most part the public has been quick to grasp the significance and importance of the system of signing. This knowledge comes, however, from the experience of driving on well-signed highways. In order that the public may be exactly informed some further publicity is needed. A single lesson in the lower grades will make it clear to children what the sign code means and what constitutes observance of it. A mere reading of the descriptions is all that should be required of the higher grades in the public schools.

To get information to the drivers of cars who live in the remoter sections of the country where main roads are few and the need for signs is not great requires that the country press be interested. This course has generally been pursued by the state departments for securing local publicity on highway matters and is satisfactory. Provision for educational work of both the kinds referred to is recommended by the permanent committee on traffic control and safety of the highway officials' association, and will be accordingly undertaken in the near future.

No census of sign installations was taken in 1930 and the exact number of signs that have been erected by all the states is not available. Last year the total was more than half a million and is doubtless larger now. Replacements are reported to range from 20 to 35 per cent normally, the average apparently being close to one-third. This is a heavy toll, due largely to deterioration, to vandalism and to necessary changes in the location of signs. Vandalism is decreasing. Respect for the road sign is, therefore, increasing. Changes in signs result from construction and other incidental changes in the road itself. Deterioration remains the heaviest item on the annual sign account. The paint or baked enamel has apparently not yet been compounded that will withstand the disintegrating effects of sunlight. Weathering and soiling compel considerable refinishing. These replacements are the work of the maintenance forces and more than any other detail emphasize the practical advantage of the standardized signs.

Adoption of the sign code in principle now extends to all the states, but some states have not followed all the details of the practice recommended. Variations are usually productive of minor revisions, because the states resort to the changes as improvements over the existing standards. Numerous changes even of detail are undesirable, but really necessary alterations can be made and installed as replacements are required.

Legislation Needed

All highway departments are now authorized to mark the state highways, but not all are directed to do so. Legislation is still needed to give departments full authority over the erection of all kinds of signs on the public highways; such authority exists today in 41 states. This general authority is in the end required if the full element of safety possible in the use of caution and danger signs is to be developed.

The legal status of road and street signs needs clarifying. In some cases decisions indicate that signs must be in place if certain restrictive regulations are to apply. If this rule is made, there should be a compensating one that signs must be obeyed. Serious danger may result if one driver relies on obedience of others, who in fact disobey the precautionary directions. This is particularly true at curves and intersections.

Unsolicited letters and comments received by the Bureau of Public Roads and by many of the state highway departments recite the good effect and usefulness of the signs and markers already installed. With closer uniformity, greater care in installation and maintenance and a more consistent and general use still greater approval will undoubtedly come. There is, of course, some objection, commonly because of misplaced, misleading or useless signs. But the public must come to realize, and does realize rather generally, that a certain degree of regimentation is necessary if our increasing number of cars, with an ever mounting mileage of operation, is to operate safely on our highways. Properly designed and placed highway signs will contribute to this regimentation by giving timely, uniform and sufficient information where needed.

Design of Highways for Traffic Safety

Safety in Design Depends Upon Proper Route Selection, and the Adjustment of Pavement Widths, Curvature and Gradients to Local Conditions

By C. H. Purcell
California State Highway Engineer, Sacramento, Calif.

Lanes 10-ft. Wide Are Safest

THE OLD ADAGE, "An ounce of prevention is worth a pound of cure," applies with striking force to the relationship between modern highway design and traffic safety. It is perfectly evident that the maximum of safety should be designed into the original plan of the highway, with the idea in mind that safety to the traffic will be obtained by enforcing the proper use of the facility provided by that plan. It follows naturally that the degree of safety which ultimately is attained depends largely on the co-operation of the public in the observance and enforcement of traffic rules, which is beyond the scope of the design. The degree of safety which can be attained depends largely on the design itself. The more important design factors relating to safety are discussed briefly in the following pages.

For the purpose of this article the highway design factors can be grouped under six general headings for detailed discussion, namely: (1) Route selection, (2) typical cross-section, (3) surfacing, (4) curvature, (5) grades, (6) miscellaneous special details.

Route Selection

The selection of route usually is determined mainly by economic considerations, but safety factors should be given their full weight in the final location, which of course should involve the minimum number of hazards.

Intersections—The widespread international interest in the control of intersections, especially those involving grade crossings of highway and railroad, and crossings or junctions of two or more important highways, is ample proof of the importance of this detail. The intersections should be as few as possible. Grade separation is either an alternative or a cure, expensive in either case and to be avoided if possible by avoiding the crossing.

Bypasses—Bypassing centers of population always has been and usually is opposed bitterly by the localities involved. The opposition is based largely on selfish and often mistaken motives. However, a slowly increasing number of communities are beginning to realize the danger and inconvenience to both traveler and resident resulting from forcing heavy traffic through the cities and towns along crowded overparked streets, in front of schools and across busy intersections. In this case again, traffic control is a cure. The necessity should be avoided if practicable.

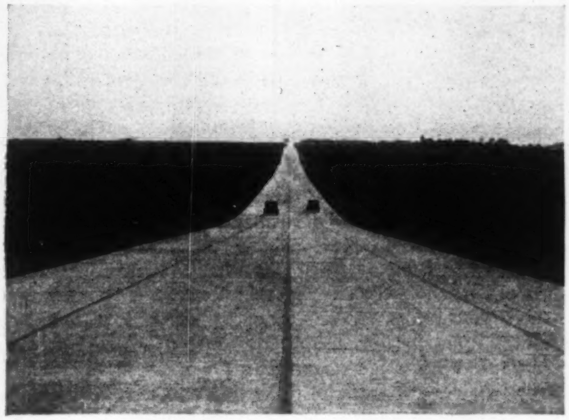
Roadway Stability—This factor often is overlooked, resulting in dangerous washouts, shoulder erosion, slides, etc. To avoid exposing the traffic to rolling rocks and slides from unstable side-hill slopes is a serious problem in many regions, especially in mountainous sections. Control of drifting snow and sand is an everyday problem of the locating engineer in certain parts of the country, involving careful study of wind currents, topography and soil classification, in order that the road may be designed to avoid the difficulties primarily by its position rather than by accessory construction. It may be well to state at this point that the difficulty and importance of the work of a good highway locating engineer is seldom appreciated and still more seldom rewarded by a salary commensurate with his responsibilities.

Typical Cross-Sections

Pavement Widths—The highway cross-section has developed rapidly in the past decade, mainly along lines tending toward greater safety at high speeds. It is well recognized now that, to accommodate normal motor traffic safely, the pavement width should be a multiple of 10-ft. traffic lanes. Some engineers advocate wider traffic lanes, 12-ft. for example, but the most efficient design seems to be the 10-ft. lane, with vehicle dimensions restricted by rigidly enforced law to conform to this design. The wider lane, applied to the usual two-lane road, not only is more expensive but sometimes tempts vehicles of average dimensions to attempt three-lane traffic, occasionally with disastrous result.

A more flexible economical alternative providing greater safety, especially on a two-lane road, is the use of crushed-rock borders, preferably oil-treated and about 2 ft. wide, along the pavement edges. Oiled shoulders accomplish the same purpose in the drier climates in addition to preventing dangerous and disagreeable dust. A smooth flush joint between pavement and shoulder is a positive safety requirement on all modern roads. This requires the use of compacted borders or treated shoulders or both, wherever the shoulder material is at all loose or soft, regardless of pavement width. As the requirement is only a precaution against occasional running off the pavement and not provision of an additional traffic lane, there seems to be no necessity for increasing the permanent pavement traffic lane width above 10 ft.

The modern tendency is to consider four traffic lanes the ultimate pavement width on fast rural roads, flanked in some cases by paved parking lanes. When traffic requires still greater road capacity an additional road seems preferable generally to more lanes on the original road, owing to the complexities existing at intersections and turnouts. The situation is modified of course if the original road has developed into an urban street. The much-discussed double-track road, consisting usually of two one-way 20-ft. pavements separated by a parking strip, is not recommended generally, as it seems to provide little if any more traffic capacity than a normal four-lane pavement with adequate traffic stripes and involves additional complications at intersections due to multiplicity of roads, in addition to greater right-of-way, construction and maintenance costs. The center separating strip, if used for vehicle parking, involves a continuous and hazardous series of left turns and crossing of traffic lines, which is entirely eliminated by the shoulder parking on the normal four-lane pavement.



Four Lanes Limit of Width for Safety

The three-lane road may be considered generally a stage in the development of a full-grown four-lane pavement. Its greatly increased capacity over the two-lane road provides relief from the congestion which a large volume of traffic creates, without incurring the heavier expenditure necessary to construct a four-lane pavement. When average traffic approaches the volume which a two-lane road can efficiently serve, peak loads often occur which greatly overtax its capacity, cause congestion and unsatisfactory service to traffic. The three-lane road offers the remedy to relieve this condition. It defers the gradually approaching congestion on the two-lane road occasioned by average traffic and relieves the overtaxed and aggravated conditions due to peak loads.

The three-lane road provides additional clearance and safety over the two-lane roads in subways and on bridges and an increased traffic capacity on heavy grades by furnishing, in effect, a double track. In this latter case the middle lane allows the faster vehicles to pass heavy trucks ascending an outside lane, and removes the extreme danger which always exists when ascending passing is attempted in even moderate traffic on a two-lane road. We all realize that this chance is taken a countless number of times a day, regardless of the constant example of resulting fatalities. On the other hand, overtaking passing by descending traffic is comparatively rare on steep grades, due partly to psychological reasons, and because the traffic usually is well strung out. Hence the head-on collision hazard is a minimum in such cases.

The use of traffic stripes to define the lanes is excellent practice. The striping may be confined to curves and summits on lightly traveled roads. On heavily traveled roads paved with materials of a color difficult to distinguish from the shoulder material at night, such as asphalt concrete, a clearly defined stripe at the pavement edge is a valuable aid to safety. In areas subject to fog traffic stripes materially assist the driver in maintaining his proper position on the pavement. The edging stripes should be a different color or width from the center stripe to avoid confusion.

Three Lanes for Safety in Passing

The crown serves the primary purpose of shedding surface drainage, such as rain water, laterally from the road surface. It is an obstacle to safe driving in that it tends to cause traffic to straddle the center line to obtain a level "set," and induces skidding. It should therefore be no greater than necessary to serve its drainage purpose. General modern practice favors a transverse crown slope of about 0.8 per cent on portland cement concrete pavements, about 1.2 per cent on bituminous and waterbound pavements, and about 3 per cent on unbound and earth surfaces.

Shoulders and Gutters

The great increase in speed of modern automobile traffic has forced upon us the necessity for wider shoulders to serve various purposes. On the more important roads the present tendency is strongly toward shoulders sufficiently wide to allow vehicle parking entirely off the traffic roadway. A shoulder width of from 5 to 10 ft. will provide this facility, 8 ft. being a commonly used width. On scenic roads comparatively inexpensive day-lighting of side-hill through cuts often will provide for the sightseer an excellent parking area safely isolated from moving traffic. Along high fills with adequate shoulders, construction of a low earth dike at the fill shoulder will serve the double purpose of a guard curb and gutter, acting as a guide to night travel (especially on curves), and will prevent erosion of the fill shoulder by surface drainage. As in the case of the pavement crown, the shoulder slope should be only suffi cient to provide suitable drainage—probably 2 to 3 per cent.

Deep side ditches and parallel borrowpits near the road are unnecessary sources of hazard in that they often retain unhealthful stagnant water and breed mosquitoes, which distract the driver's attention and menace his health, present greater opportunities for accident especially if they become camouflaged by drifting snow, and trend like a fill to crowd traffic away from the shoulder toward the center of road; also an accident may have more disastrous result than if there is a gradual slope from the shoulder. Normally a shallow V-side ditch about 1 ft. deep and 2 ft. wide is sufficient for longitudinal drainage on a well-designed road. If side borrow or larger ditches are necessary, a safe, pleasing and easily maintained design can be obtained by using a turnpike section with a gentle downward slope away from the roadbed shoulder extending as far as necessary into the right-of-way. This will also avoid the future necessity for backfilling the original borrowpits when the road is widened.

Edge Stripes Are Valuable Safety Aids

It is especially desirable that transitions in roadbed width be made gradual. For example, a widened cut should never open abruptly onto a narrow fill. Any transition in standard should be extended over a sufficient distance to avoid surprising the traffic.

Surfacing

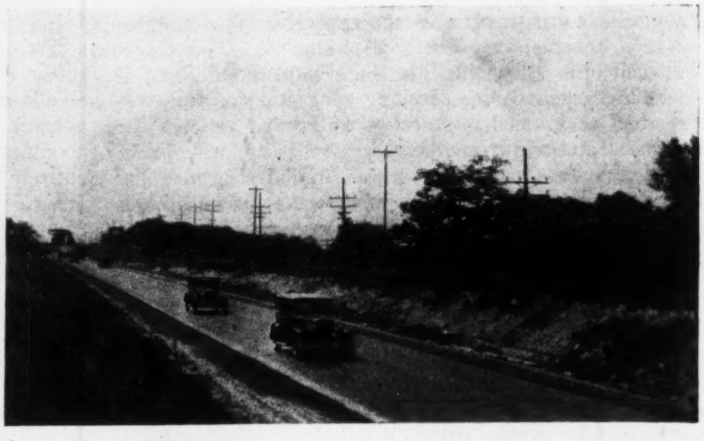
With modern methods of construction a non-skid wearing surface can be built into many types of pavement, greatly increasing the factor of safety. As stated in a previous paragraph, there is an element of danger involved in distinguishing the edges of a bituminous pavement unless the edges are defined by striping. It seems also that more attention should be given to the surfacing color and to the problem of glare, but generally speaking, the safety of the pavement itself depends more upon construction and maintenance—character of the surface, integrity of the shoulders, etc.—than upon design. Loose sanding or graveling of road surfaces is considered very poor practice except as a stage in progressive construction leading toward a firmly bound surface, the loose surface being both dangerous and uneconomical.

Curvature allows the designer a very broad field for exercise of his ingenuity and common sense. Traffic safety probably depends more on the curvature design than on any other conventional major item of the detailed design. A very complete, scientific, and consistent technique of curve design has been worked out during the past two years by the engineers of the department of surveys and plants of the California division of highways. The following notes are derived from the practice of that department.

The selection of standard and minimum curve radii for any project requires fine judgment. There is little doubt that most generally accepted highway-curve standards are arbitrary, the present tendency being toward extreme and even unnecessary design in the supposed interest of safety. Actually uniformity and consistency, superelevation, spiraling and widening are far more important than radius or degree of curvature. For example, a properly superelevated 1,000-ft. radius curve can be traversed safely and easily at 60 miles an hour, and a 2,000-ft. radius curve without superelevation can be traversed at 75 miles an hour, so far as centrifugal force alone is concerned. On the other hand these same curves applied to a 20-ft. pavement with a 5-ft. shoulder, 2-ft. side ditch, and 1 on 1 cut slopes will allow respectively only about 300 and 400 ft. of sight distance on a straight grade to the traffic on the inside lane, which will limit the safe speed before the centrifugal influences become dangerous.

Without further evidence it is plain that the intelligent selection of curvature standards depends on too many variable factors—speed, roadbed, width, grade, topography, climate, etc.—to permit statement and explanatory support of a series of controlling rules in this article. Speaking very generally, it seems that in open country with unlimited visibility there is no justification from the safety viewpoint alone for additional expense to obtain curves flatter than 2,000-ft. radius, although longer radii should of course be used if they are justified by other factors, such as economics.

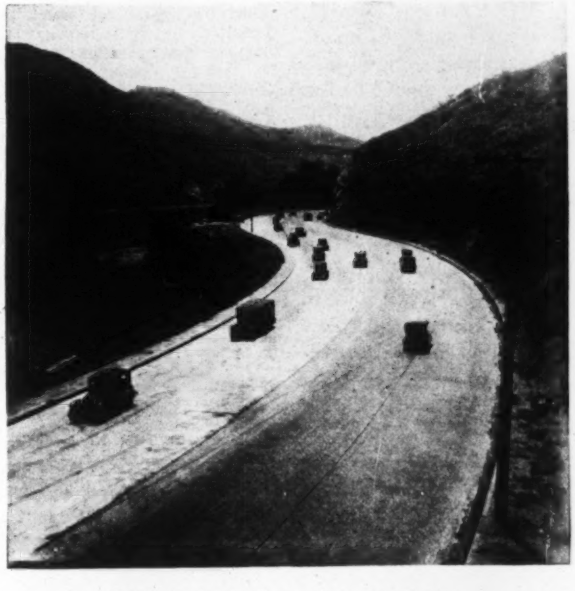
Another general rule is that the curvature on a grade should be at least easy enough to handle traffic safely at the average speed attained by vehicles descending in compression, but using neither power nor brakes. In more difficult country the writer believes that the standard should be decided on the requirements of the individual case, and does not believe it possible to state a generally applicable dimension rule for this broad problem. In fact, contrary to the popular impression, it is believed that the actual curve radius is a relative factor having very little fundamental effect on traffic safety.



Wide Surfaced Shoulders and Shallow Ditches Are Safety Factors

We all know that it is impracticable to design difficult mountain roads for open valley speeds. We know equally well that traffic cannot operate through city streets at rural speeds. It seems then that traffic safety on curves depends very little on the standard of curvature, but mainly on the design of the curves, which is discussed in detail in the following paragraphs, and on the intelligent use of the road by the traveling public.

The accident-free record of many of the most apparently dangerous sections of road in the world supports the above conclusion, which at least merits careful consideration where the choice between relative standards of curvature, from the safety viewpoint alone, involves large differences in cost. The economic problem is an issue entirely distinct from safety, and the two should not be confused.



Safety Depends Most on Curve Design

Curvature should be uniform and consistent. This probably is the most important detail of highway-curvature design from the safety viewpoint. Sudden changes from easy to sharp curvature are unsafe, and the transition should be accomplished over a distance sufficient to allow the driver ample time to come to a full realization of the change and to adjust his speed accordingly. In fact it is often possible to design curvature so that speed control is practically automatic and the driver is hardly conscious of a change in standard, which may be really quite radical.

Compound curves are to be avoided if reasonably possible. When used it is recommended that the difference in length of radius of any two contiguous arcs shall not exceed one-half the length of the shorter radius if either radius is less than 1,000 ft. The purpose of this limitation is to hold within reasonably safe limits the centrifugal effect which tends to cause a vehicle to swerve from its normal traffic lane when entering a curve or passing from a flatter to a sharper arc in a compound curve. The limitation is removed when the radii exceed 1,000 ft., as a properly built and superelevated 1,000-ft. radius curve can be traversed easily at unlimited speed under normal conditions. In the case of certain difficult locations where the use of simple curves is impracticable and the physical controls dictate the use of either compound curves with great differences in arc radii or broken-back curves (curves in the same direction with a short intervening tangent), the broken-back curve is considered the safer alternative, inasmuch as it definitely sets out the curves, thereby inducing caution and eliminating surprising changes in radii, which are especially imperceptible to the eye and dangerous at night. Thus, sacrifice of appearance in favor of safety is recommended, the sacrifice usually being further compensated by a reduction in construction cost and length. It seems almost superfluous to note that a sharply contrasted compound curve on a steep grade, with the shorter radius at the lower end, is poor and unsafe design—still worse if the transition point is on fill.

Reversing curves should be separated by an intervening tangent as long as possible, and at least long enough to allow application of a proper superelevation transition. The principal hazard of the reversing curves lies not so much in the curves themselves as in the fact that, when too close together, lack of room for the superelevation transition causes unbalanced centrifugal forces, or a too sudden transition will impose unduly steep grade pitches against ascending vehicles on steep grades and will sometimes cause disconcerting swerving. The intervening tangent should be as long as possible, but in difficult country with properly designed superelevation the tangent can be reduced to 100 or even 50 ft. with perfect practicable safety.

For Safe Driving There Should Be a Tangent Between Reverse Curves Wherever the Topography Permits

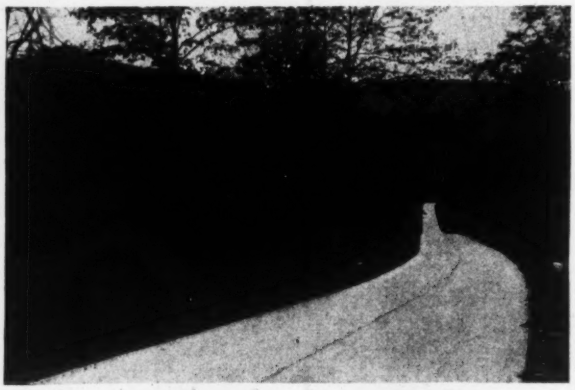
Curves should be avoided in grade-line sags if possible, not because they are actually difficult to negotiate, but because certain optical distortions are produced which make the curve appear worse than it is and tend to confuse the driver. A noticeably sagging curve almost invariably forces the unfamiliar driver toward the center or inside of the curve when the direction of curvature is toward his left.

Curves on grade summits should be designed if possible to cover completely and overlap the vertical curve, in order to direct the driver's attention to the change of direction before he starts over the blind summit. A horizontal curve beginning within a summit vertical curve is partly concealed by the latter and may come as a surprise to the driver, especially at night, resulting in departure from the normal traffic lane. The application of this recommendation is well worth additional initial cost where sharp curvature is involved.

All highway curves should be superelevated to counteract the centrifugal effects. The proper design of a superelevation is really a difficult problem, owing to the great number of conflicting requirements, and space will not permit detailed discussion here. The design varies widely in the different road-building organizations. The standard superelevation now used by the California division of highways, which was designed by N. D. Douglas of the department of surveys and plans, has proved unusually satisfactory and presents several unique safety elements. It is based on the following principles:

> Theoretically exact neutralization of the centrifugal force is not necessary. It is necessary that the resultant forces acting on a vehicle on curve be retained within safe limits.
>
> Superelevation must provide safety *without* limiting operating speeds.
>
> It should provide at any given speed a uniform effect on the vehicle regardless of the radius of curve.
>
> It should be adapted to a sliding scale of speeds—for example, much faster speeds are practicable on 1,000-ft. radius curves than on 300-ft. radii for limiting reasons entirely distinct from the length of radius.
>
> It should be simple in theory and application and adaptable to all conditions.
>
> The superelevation transitions between tangent and curve and between different types of curvature (reversing curves, etc.) should provide easy natural riding, should avoid pitching, especially on steep grades, and should be as short as possible while meeting these requirements.

The California design varies uniformly from a maximum transverse slope of 12.8 per cent on a 400-ft. radius curve to 1.6 per cent on an 1,800-ft. radius, the transverse slope decreasing 0.8 per cent with each 100-ft. increase in radius. This rate allows conservatively safe speeds of 40 miles per hour on a 400-ft. radius, 50 miles per hour on a 600-ft. radius, and 60 miles per hour on a 1,000-ft. radius, with ample allowance for higher speeds in emergencies. Curves of more than 1,800-ft. radius are superelevated by using a one-way crown equal to the standard rate for the type of surface. To fit special cases of wide urban streets, difficult mountain roads with sharp curvature or second-gear grades, etc., the standard superelevation should be reduced one-third, one-half, etc., according to necessity.



Sags Introduce a Special Hazard

Paved curves up to and including 1,200-ft. radius should be designed with spiral approaches. This refinement has not yet been included generally in California state highway practice, but probably will be in the near future. There is some difference of opinion among engineers as to the proper design of spiral. A design of unusual simplicity, and involving no mathematics beyond simple plane trigonometry, is based on the following principles which make for both safety and convenience:

> The purpose of the spiral is to provide a transition from a tangent to a curving path, which will also fit the transition from normal to superelevated cross-section, so that the approach to the curve is rendered practically imperceptible, and swerving tendencies are eliminated.
>
> The spiral should conform as closely as possible to an easy natural path, which normally would be followed by a vehicle entering a curve without the restriction of a defined roadbed. At the same time it should be as short as possible to avoid assuming the objectionable features of a compound curve. Its length should be sufficient to allow the driver to adjust his steering gear to the curve, but not long enough to give the impression of constant change in degree of curvature. A length of 100 to 150 ft. is sufficient. The general tendency is toward too great a length, which reduces the efficiency and safety of the spiral as applied to highway curves.
>
> For the sake of uniformity, consistency and simplicity the spiral approach should be the same for all curves regardless of radius, the only variation being in the length of spiral. This makes for confidence on the part of the driver.
>
> The spiral should be mathematically exact, free of approximations, and simple in theory and application.
>
> Spiraling curves of more than 1,200-ft. radius is unnecessary, as the variation between a suitable spiral and the circular curve is practically negligible.

A properly designed spiral will almost automatically confine the vehicle to its proper traffic lane and eliminate swerving and the hazard of side-swiping.

Curve widening applied to the inside of the curve is a most important aid to traffic safety, serving three distinct purposes: it provides increased clearance between vehicles, increased sight distance, and a spiral approach to the curve. The last effect is obtained by painting the center traffic stripe parallel to the inside edge of the pavement and at the same uniform distance therefrom on both unwidened tangent and widened curve. Here again standard practice varies greatly in the several highway organizations. The standard California widening consists simply of moving the inside edge of pavement on the curve toward the center of curve (in other words shortening its radius) and connecting this shifted concentric curve to the edge of the tangent pavement by a compounding circular arc. This design is based on the following principles:

> The widening varies from 2 ft. on a 500-ft. radius curve to 4 ft. on a 200-ft. radius.
>
> Widening of curves of more than 500-ft. radius is considered unnecessary in connection with 10-ft. traffic lanes, as the overhang of vehicles conforming to legal limits is negligible. Spiraling the flatter curves still further regulates traffic and reduces necessity for widening.
>
> Widening is the most satisfactory method of spiraling the sharper curves under 500-ft. radius on account of the additional safety features and simplicity of application. The expense is approximately the same.
>
> Considering the speeds on curves of less than 500-ft. radius and the usual difficulty involved in securing tangents between reversing curves, etc., a widening transition length of about 75 to 100 ft. is considered most efficient.
>
> The theory and application must be mathematically exact and simple. Lack of simplicity—in other words, plain cumbersomeness—is the greatest drawback to the general application of the spiral, widening, and other essential curve refinements.

The grade design affects traffic safety mainly through the detailed vertical-curve design and through the correlation of grade and curvature, which was discussed in previous paragraphs and need not be repeated here. The rate of grade, within the limits of modern good practice, does not have a serious influence on safety, provided that these two elements are cared for properly.

The one main safety factor which is peculiar to the grade line alone is the vertical sight distance on summits. Minor summits should be avoided as much as possible to reduce direct headlight glare. On necessary summits the visibility should be as long as reasonably possible, the tendency being toward a minimum mutual visibility on tangent alignment on two-lane roads of 600 ft. or more between objects 5 ft. above the road surface. The writer takes exception to two generally accepted points of practice in recommending that:

(a) In general no distinction in standard length of visibility should be made between primary and secondary roads of any importance.

(b) If economical in other ways, the standard length of visibility can safety be reduced on roads of four lanes or more.

The reasons for the first point are that visibility is far more a function of speed than of traffic density; that speed normally increases as traffic density decreases; and hence that the visibility requirement is a fairly well-balanced necessity.

The reason for the second point is that the wider road provides for greater flexibility of operation, requiring less rigid control, hence a decreased necessity for the especially long visibility of stopping distance which must be provided by long vertical and horizontal curves on a two-lane road.

A Wide Intersection

On horizontal curvature the vertical sight distance should be at least equal to the horizontal sight but need not exceed it by an excessive amount. A safe general rule of correlation is that the vertical visibility should equal, or slightly exceed, the maximum horizontal sight distance in the outside lane of the ultimate pavement proposed for the project. Adherence to this rule will avoid necessity for future grade revision and pavement removal when the road is widened progressively.

Miscellaneous Special Details

The number of accessory aids to safety in the road design is entirely too great to allow complete tabulation in this article. Brief attention is called to the best modern practice relating to a few of the more important items.

Bridge, subway, tunnel, and curb-pavement widths should be at least 2 ft. wider on each side than the normal pavement. Curbs should not be high enough to engage vehicle wheel hubs. Raised unprotected bridge sidewalks, especially on the inside of curves, are exceedingly dangerous to vehicle traffic. Culvert headwalls should be placed well beyond the limits of the graded shoulders. The danger of light wooden guard rails is proved by the many instances where cars leaving the road have been impaled on the rails. A guard rail combining the features of a substantial timber hub rail and a wire rope is being tried in several localities and appears to be satisfactory. Culvert headwalls, guard rail, trees, poles, etc., should be painted white as an aid to night driving.

A most important subject of divided engineering opinion is the Y intersection. The writer believes that, in the general case, a simple connection with a flared area at the intersection and a stop sign against the minor road is preferable to a high-speed Y. Intersecting traffic lines are reduced to a minimum, and safety is obtained at the expense of perhaps a small loss of time. The simple connection is usually much cheaper to build.

Drive entrances should always when possible de designed to allow the entering vehicle to stop and obtain a clear view both ways before entering upon the main-road shoulder. Wherever necessary the entrance should be surfaced to eliminate the necessity for "running" the intersection to avoid getting stuck in mud, etc.

It seems unnecessary in this paper to do more than call attention to the value of uniform road traffic signs as adopted by the American Association of State Highway Officials, to the necessity for clear visibility at intersections, and to numerous other features, many of which may well be the subjects of exhaustive study and special articles.

Conclusion

In closing this article the writer wishes to emphasize what he considers the most important single major safety characteristic of the road design. *Uniformity.* Accident records from all over the country indicate strongly that it is not the relative standard of the design but rather the all too prevalent lack of uniformity of the details of the design which contributes most, not only to the liability of accident, but in some cases to economic inefficiencies in our road systems.

It is up to the highway locating and designing engineers to incorporate into the design a high degree of plain common sense in connection with the most difficult of all properties to attain: *uniformity*, or expressed in a broader term, *consistency*. If this is done properly, the driver can traverse the road with assured confidence and freedom from nerve straining, dangerous surprises in the form of sudden changes in curvatures, etc., which tax his vigilance at the expense of legitimate cautions. When this ideal of design is attained, the bulk of the responsibility for traffic safety then can be passed on conscientiously to the maintenance engineer and to the traffic-control authorities.

* * *

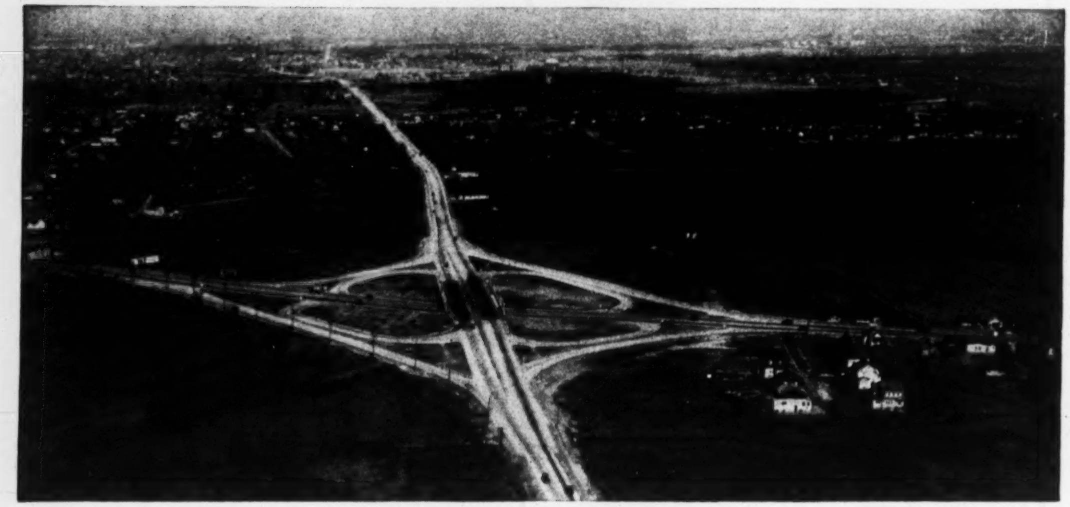
Fast Durability Tests of Bituminous Materials

Accelerated weathering tests on bituminous materials have been devised by the national Bureau of Standards whereby indications as to the probable durability may be obtained after 10 to 20 cycles of exposure in an "accelerated weathering machine." O. G. Strieter, of the bureau, describes the machine in the November issue of *Commercial Standards Monthly*. Exposure to actual weathering frequently requires a number of years. In the laboratory test the material is subjected to alternate exposures of light from an inclosed carbon arc lamp, to water spray and to refrigeration. The time required for the bituminous material painted 0.025 in. thick on aluminum panels to crack through indicates the durability.

Securing Traffic Safety at Intersections

Review of Various Practices Reveals Need for Exercise of Further Ingenuity and Thought

By Clifford Older
President, Consoer, Older & Quinlan, Consulting Engineers, Chicago, Ill.



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Clover-leaf Intersection in New Jersey

IT HAS been found difficult in this article to keep to the subject. The question of traffic delay caused by certain safety provisions constantly intrudes as do also over-all transportation costs as influenced by traffic delay, cost of right-of-way, property damages, construction costs and the cold-blooded railroad attitude of offsetting the average cash cost of sacrificed human life against interest on investments in safety provisions. One may even speculate on whether one is justified in introducing safety provisions at a busy crossing that might cause an accumulation of lost time equal to the average human life span, in a shorter period than the average period of loss of life, in case safety provisions were neglected.

We are prone to think that an absolutely unobstructed view when approaching an intersection tends to promote safety. A concrete example cited in the article points in another direction. In this particular case conditions for several miles in each direction from the intersection are so apparently ideal for safety at high speed that auto speeds of 50 to 70 miles per hour or even more are common. Under such a condition, where the sole indications of an intersection are the signs along the widened approaches, these have proved grossly inadequate for timely warning. The danger in this case is greatest in broad daylight; the headlights of a vehicle on the intersecting road at night become conspicuous in ample time, but during the day the rapidly moving vehicle body is overlooked.

This observation is perhaps new enough to be of some value in states having open prairie areas.

The ideal highway intersection might be defined as one that would, without increasing over-all transportation costs, provide means whereby a vehicle approaching the intersection might continue in a straight path, or turn right or left at normal speed without interfering in any way with the normal movement of any other vehicle. Unfortunately, the design and construction of such an intersection seems about as feasible as perpetual motion.

Ordinary Provisions

The simplest and most commonly used safeguard is the mere erection in accordance with standard practice of non-illuminated signs indicating the existence of a crossing ahead. Standardization of warning sign practice has undoubtedly had a marked effect in minimizing accidents but has not eliminated the danger of inattention on the part of drivers and the effect of poor visibility under adverse conditions. There also remains the more or less serious delay caused by the needed caution, which becomes pronounced in the case of traffic even approaching the maximum elsewhere feasible. The erection and maintenance of standard signs should be the minimum safety precaution and never neglected.

It is hardly necessary to state that stop signs should invariably be provided on relatively unimportant side roads that enter or cross a main highway at grade, whether or not such side or cross roads be surfaced.

Widened Approaches

It is often the practice to widen the pavement to double width for some distance in each direction from an intersection of main highways. This practice no doubt adds somewhat to the safety factor. Drivers become familiar with the characteristic and more or less conspicuous appearance of the widened approaches, and although they may overlook the standard signs, still they may be made aware of the proximity of the intersection. The additional width also provides more room for maneuvering in case of an apparently impending accident. For the same reasons Y turns within the angles are believed to promote a certain degree of caution.

Low hedges, trees trimmed high or other objects associated, perhaps unconsciously with highway borders, if not unduly obstructive to the view, are of real service. A certain intersection of straight paved roads in a broad flat open prairie of Illinois near Chicago has been the locus of a number of serious accidents, although a car on either road may be seen from the other for a great distance in any direction. There are no stationary objects of any kind (except standard signs) along either highway to indicate the existence of the other, and often the traffic on one or the other of the highways is not sufficiently dense to be conspicuous. Huge striped danger signs were soon found necessary to prevent high-speed collisions in broad daylight.

INTERSECTION BRIEFS

Traffic circles promote safety but slow up traffic
Standard signs always necessary
Widened approaches warn of crossings
Stop-and-go lights useful but impede traffic
Further ingenuity in design needed
Clover-leaf intersection safest of modern designs

Stop and Go Lights

Modern stop and go lights no doubt provide a relatively high degree of traffic safety. In spite of the cost of erection and maintenance they would probably be used much more freely were it not for the reluctance of public officials to impose the traffic delay that continuous automatic operation in rural territory would more often impose than not.

It is suggested that studies of traffic-density periods might lead to the logical installation of a series of stop and go lights in heavy traffic territory, to be placed under periodic control by an attendant. It might often prove that one attendant could serve a rather large territory, adjusting the time period of the traffic lights best to suit the prevailing traffic tendency at given hours.

Traffic Circles

Experience indicates that traffic circles or "mills" of reasonable diameter and with an ample width of pavement around the circle are reasonably safe. They are not particularly popular, however, because of the delay imposed upon all traffic. They are of doubtful value on highways carrying traffic of moderate density, otherwise designed to accommodate normally high speed.

Highway Grade Separations

The grade separation seems to offer the best possibilities of providing for traffic safety with the least delay to the flow of traffic. The problem then becomes one of how best to provide for left turns and how to meet the cost and the objections of owners of adjacent property. Right turns present no special problem except as to right-of-way costs when comparatively long radius curves are provided in the angles. When such curves are not provided and ramps to permit the interchange of traffic are kept within ordinary right-of-way limits, right-turn traffic must stop or proceed with great caution on account of the sharp turns, and left-turn vehicles must cross the path of one line of straightaway traffic and also make sharp turns.

While grade separations of this type may greatly reduce traffic delays where the predominant traffic is straight through in each case, such locations are rare and it is doubtful if separations ever contribute materially to traffic safety.

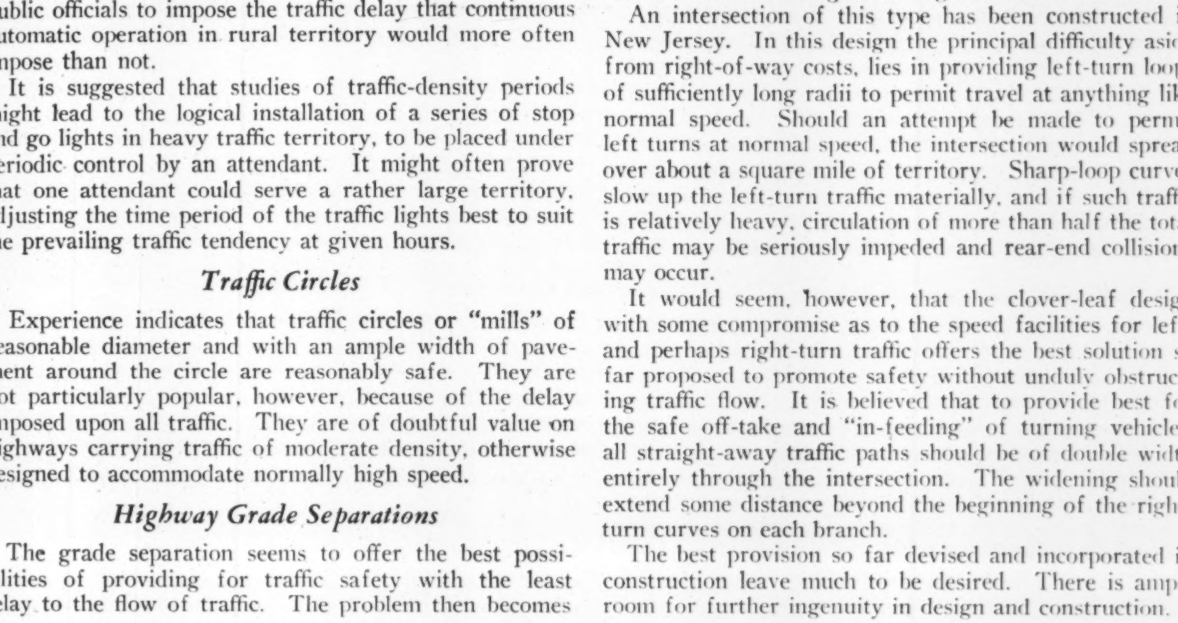
Clover-Leaf Intersections

Perhaps the closest approach to the ideal intersection is the so-called clover-leaf design. In this design the through traffic is provided for by a grade separation, right turns by simple long-radius curves within each angle and left turns by loops within each right-turn path. Vehicles making a left turn pass over or under the bridge and then circle 270 deg. to the right around the next loop.

An intersection of this type has been constructed in New Jersey. In this design the principal difficulty aside from right-of-way costs, lies in providing left-turn loops of sufficiently long radii to permit travel at anything like normal speed. Should an attempt be made to permit left turns at normal speed, the intersection would spread over about a square mile of territory. Sharp-loop curves slow up the left-turn traffic materially, and if such traffic is relatively heavy, circulation of more than half the total traffic may be seriously impeded and rear-end collisions may occur.

It would seem, however, that the clover-leaf design with some compromise as to the speed facilities for left- and perhaps right-turn traffic offers the best solution so far proposed to promote safety without unduly obstructing traffic flow. It is believed that to provide best for the safe off-take and "in-feeding" of turning vehicles, all straight-away traffic paths should be of double width entirely through the intersection. The widening should extend some distance beyond the beginning of the right-turn curves on each branch.

The best provision so far devised and incorporated in construction leave much to be desired. There is ample room for further ingenuity in design and construction.



Traffic Circle Intersection in Michigan

Protection at Special Danger Points

As for Example:

Wherever Unexpected Changes in Road or Driving Conditions Exist; Where Curve Frequency Is Small; at Grades, Summits and Dips, Soft Shoulders, Icy Surfaces, Bottlenecks and Intersections

By C. S. Mullen
Chief Engineer, Department of Highways, Richmond, Va.

IN THE location and design of modern highways, dangerous conditions are as a matter of course foreseen and avoided as far as possible. There are, however, approximately three million miles of public roads in the United States, and a rather small percentage of this vast mileage is of modern design. Traffic is not confined to the modern roads, and it is apparent that careful study should be given the older roads and proper caution signs erected at all points where road conditions create special traffic hazards.

This article presents some of these conditions, and gives the actual methods in use for the protection of traffic, and in some cases suggests methods which are not at the present time common practice.

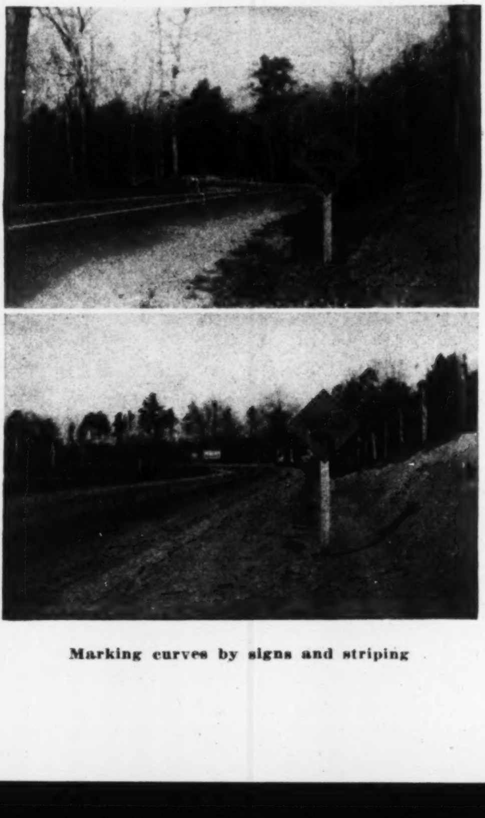
Special Hazards on Curves

Every curve is potentially dangerous because it introduces a changed driving condition and because of a very natural inclination to cut to the inside of a curve while driving on it. Thus the driver having right of way on the inside of the curve may be suddenly confronted by an approaching car on the wrong side of the road, and the potential danger of the curve is at once developed. The common practice to prevent this hazard of the highway is to mark the center line on all curves with a white stripe, thus clearly defining the traffic lanes.

Infrequency of occurrence of curves increases their possibility of creating hazards to traffic. In heavy mountainous country, where highways are frequently an almost unbroken succession of curves, the driver is constantly on guard and is seldom caught unaware. In more level country where long tangents are the rule, speed is increased and the infrequent curves connecting long tangents constitute special danger points and should be very carefully marked. For flat curves the curve sign should be placed at such a distance back on the tangent that the driver will have ample time to reduce speed and have perfect control of the car upon reaching the curve. In this condition the center line stripe should be extended a long distance back along the tangent.

This condition is even more dangerous at night as the driver may be confused by the lights of an approaching car and be on the curve before he is aware of it, unless properly forewarned. The use of luminous signals for protection at night is rapidly increasing. The most satisfactory reflector type is one in which small reflecting units, commonly called buttons, are used to outline the words and symbols used on the standard signs. These signs are visible at night for a considerable distance, even against the light of an approaching car.

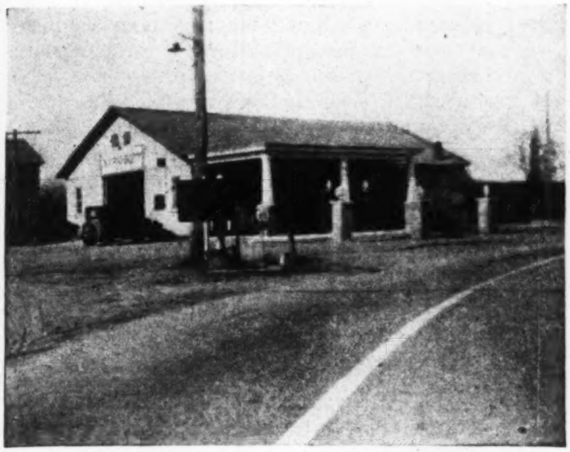
When the curve connecting two long tangents is sharp the same marking as is called for on the flat curve should be used; and in addition to this a rectangular sign, painted with diagonal stripes, alternately yellow and black, with a large arrow in the center, should be erected on a line which is a prolongation of the tangent beyond the point of the curve. This sign should also be illuminated with reflector units.



Marking curves by signs and striping

The long curve with a large central angle creates a very deceptive hazard. It is common practice for a driver, having entered a curve with his car under control gradually to increase speed. On short curves there is no particular danger in this. But on the long curve there is danger of the car going out of control due to the increase in centrifugal force caused by the acceleration of speed. This condition is not ordinarily protected by marking, but it is suggested that some special marking should be used when this danger exists.

On modern highways curves are superelevated, and very little slackening of speed is required to take them safely. On the older roads superelevation is rare. As the older roads are constantly being modernized, it frequently happens that a section of modern highway will be adjacent to a section of the older type, and in such cases driving conditions are abruptly changed as one passes from the modern highway. It is quite possible that the first sharp curve encountered on the older section may cause a serious accident



Dangerous curve sign on which arrow points direction of tangent. Colors are yellow and black

Hazards at summits minimized by center line striping, with parking opposite line prohibited

unless the driver has been forewarned of the change in road conditions. As proper marking under these conditions, it is suggested that at the point where the modern type joins the older type, a sign be erected, advising the driver of the changed condition, and giving the length of the section where special care must be exercised on curves.

Hazards at Summits

While highly desirable, it is not always possible to provide adequate sight distance at the intersection of ascending grades, and severe accidents often occur at these points when the sight distance is insufficient for approaching cars to be seen for a reasonable distance before reaching the summit.

These accidents are generally the result of a careless or reckless driver attempting to pass another car near the top of a hill; being on the wrong side of the road he is unable to get back to the right side in time to avoid a head-on collision with an approaching car. Although the reckless driver has little regard for signs, accidents can be reduced at such points by proper marking, which should consist of the center line stripe and signs prohibiting parking opposite this stripe. When the paved surface on such hills is less than 18 ft. the pavement should be widened to 18 ft., and preferably to 20 ft., for a distance of at least 200 ft. on either side of the summit.

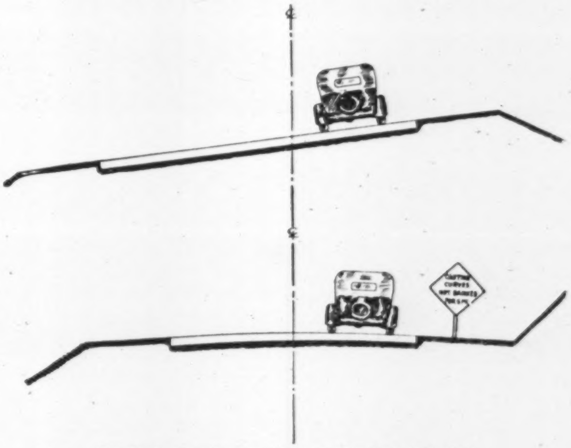
Hazards of Steep Grades

In mountainous country it is frequently necessary to use maximum grades, even on modern locations, running as high as 8 per cent, and occasionally higher. The descent of these steep grades presents a decided hazard to the driver whose experience has been confined to level and gently rolling country. Such a driver is accustomed to the use of brakes to retard the car on hills and is very likely to attempt this method when he first encounters the long steep grades of the mountains. The result is frequently burned out brakes and occasionally complete loss of the car by fire. Customary practice to avoid such contingencies is the erection of a sign at the top of steep grades, advising descent in second gear.

Weather Hazards

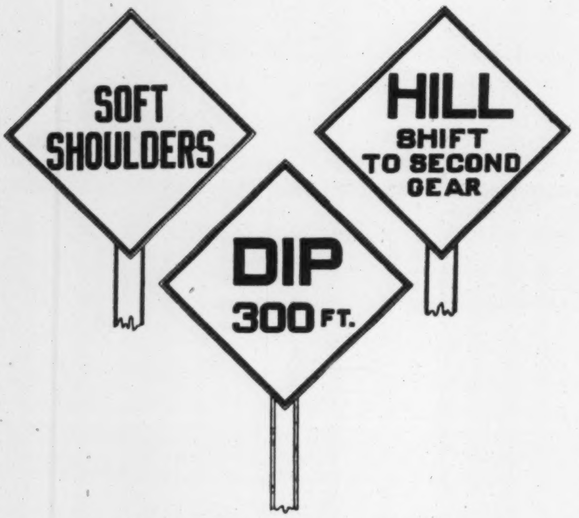
In periods of heavy rains pavements are not much more dangerous than in dry weather, because at such times the surface is generally washed clean of dust and oil dropping. But in rains or mist too light to cleanse the pavement the wet dust or oil becomes exceedingly slippery, and careful driving is necessary to avoid accidents. It is not customary to erect warning signs on account of this danger, except on hills where the condition has been observed to be particularly bad. At such places a sign is placed, warning the driver that the road is dangerous in wet weather and that brakes should be used cautiously.

Ice and sleet constitute a seasonal danger, and when of general occurrence give their own warning. Where the condition is purely local, as on shaded sections, the danger from this source is greatly increased, as the driver approaches these places with no possible knowledge of the danger unless forewarned. Therefore, roads should be carefully watched during the season when this condition is likely to occur, and temporary warning signs should be placed where required. Contrary to the usual custom of erecting signs at the side of the road, these signs should be placed in the middle of the road and should carry a red flag in the day and a red lantern or reflector at night.



Banked curves require no signing, but flat curves should always be plainly marked

In addition to placing the warning signs, whenever it is possible sand or cinders should be spread on the ice-covered surface to roughen it and reduce the danger of slipping.



Typical signs for special hazard points

Fog creates a hazard against which there is no protection available other than careful driving and the burning of headlights.

Earth shoulders adjoining pavements are not constructed to furnish additional driving width, but for the support and protection of the pavement. It is inevitable, however, that cars will frequently run out or be forced out on the shoulders; and if the shoulders are soft because of fresh earth placed for repairs or because of preparation for seeding to grass, a special danger is created that leads to many serious accidents. Proper marking to warn of this danger is the placing of temporary signs on the shoulder and maintaining them until the danger has been eliminated.

The bottle neck is created when traffic from an adequate highway is drawn into a narrow road or bridge. Until they are eliminated by construction of proper width, such points must be carefully marked to prevent accidents. The governing principle in this type of marking is to make the transition gradual instead of abrupt.

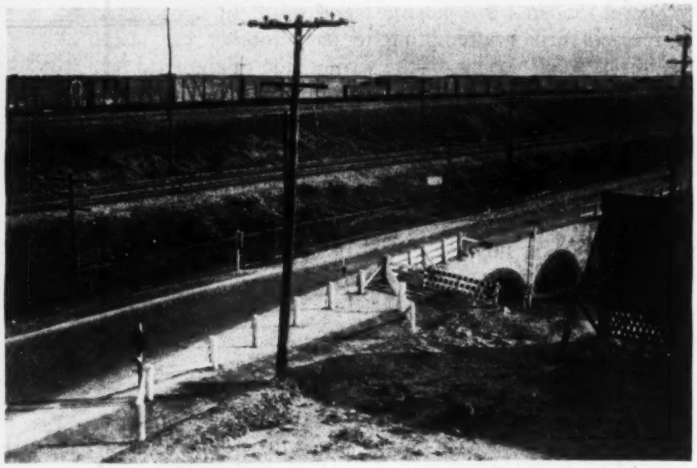
A typical case will serve to illustrate this situation. On U. S. route 1 the section between Washington and the city limits of Alexandria, Va., was widened from an 18-ft. surface to 30 ft. early in 1930. At the city limits of Alexandria there is a bridge over Four-Mile Run, having a roadway of only 20 ft. with the center line of the bridge 5 ft. east of the center line of the new 30-ft. pavement. This put the prolongation of the southbound traffic lane completely off the bridge, so that southbound cars were forced to swerve sharply to the left to enter the narrow bridge. This point was protected immediately after construction by a woven wire barricade, illuminated at night with reflectors which extended west from the northwest corner of the bridge and approximately at a right angle to the center line of the roadway. Frequent accident reports from this point quickly demonstrated that this method of protection was entirely inadequate. A careful study was made and a wing guard-rail was erected, extending from the northwest corner of the bridge and gradually flaring to the outside of the pavement. This served to guide traffic gradually into the bridge, and accidents at this point have been eliminated.

Highway intersections present such a varied combination of conditions that standard markers for such points are impossible. In general, there are two principles to be applied at all intersections, the first being adequate information of the existence of the intersection, and the second the proper regulation of traffic. The most dangerous intersection is one where two main highways cross and the view is obstructed by buildings, cut banks, roadside growth or otherwise. The first consideration at such points should be the removal of the obstructions, and except in the cases of buildings this can generally be accomplished.

Marking at Intersections

Proper marking should consist of road intersection signs at a reasonable distance back from the point of intersection, supplemented with speed limit signs designating the speed which should afford a safe approach to the intersection. Where minor roads intersect main roads, traffic on the minor roads should be required to come to a full stop before entering the main road. In the event the law of the states does not allow the use of stop signs at such points, the speed of cars approaching on the minor road should be reduced to a minimum of not more than 5 miles per hour.

Where standard methods of protecting intersections by road side signs cannot be made effective, recourse may be made to an automatic stop and go system. This system is installed so that the "go" light will be maintained constantly on one of the highways, except where changed to "stop" by an approaching car from the other highway, passing over a magnetic detector buried in the road. This detector reverses the regular order of the lights and allows the car which has passed over it time to clear the intersection, at the same time stopping traffic on the other highway.



Wing guard rail leads traffic from a wide pavement into a narrow bridge

Dips in the Pavement

This is a form of hazard which has no place on a modern road and yet exists at the present time at a few points on some of the main interstate routes. It is caused by a depression of the pavement for drainage purposes on sections of road which must be relocated, but which have not been provided for in the construction budget. Unmarked, these dips present points of ex-

Danger point at intersection eliminated by cutting back of banks

treme danger. The proper and effective marking is the erection of signs 300 ft. on either side of the point where a dip in the pavement occurs. Final location of the signs will, of course, depend upon local conditions.

Conclusion

1. Special danger points on highways are generally to be found at points where there are unexpected changes in road or driving conditions. Danger at such points can be materially lessened by proper marking or signalling.

2. Care should be exercised to avoid unnecessary, obscure or misleading signs.

3. On important highways, signs should be equally visible by day and by night.

4. State traffic officers should co-operate with the highway departments by enforcing traffic regulations and educating the public in a proper understanding of, and regard for, the signs, signals and markings which have been placed on the highway in the interest of public safety.

Automobile-Operating-Cost Data

ACTUAL operating costs for automobiles based on exhaustive statistics accumulated over a period of six years ended December, 1929, recently have been released by the California division of highways. These figures were compiled from the complete individual records of almost 1,500 cars and trucks operated by the division during this period. The summary presents some valuable statistics on the operating costs of motor vehicles, because the length of the record and the large number of cars involved tend to make representative figures.

The accompanying table shows the average statistics as accumulated for those makes and types of cars and trucks which were in service in quantities of ten or more during the last six years, the table indicating the number of vehicles in each case, the average number of miles driven and the average cost items. All known items of cost other than those listed in the table were included.

SUMMARY OF AUTOMOBILE-OPERATING COST, PASSENGER CARS AND TRUCKS, JAN. 1, 1924, TO DEC. 31, 1929
Division of Highways, Department of Public Works, State of California

					Average Cost Per Mile				
Make and Type Passenger Cars	Number of Vehicles Used	Average Mileage	Aver. Miles Per Gallon Gasoline	Aver. Miles Per Quart Oil	Tires and Tubes	Repairs and Greasing	Total Operating, Including Gas and Oil	Depreciation Cost Per Mile	Grand Total Cost Per Mile
Buick "6"	14	32,873	13.95	130.82	$0.0063	$0.0208	$0.0406	$0.0204	$0.0610
Chevrolet "4"	31	28,425	17.56	156.26	0.0029	0.0152	0.0297	0.0142	0.0439
Chrysler "4"	21	53,525	16.67	97.37	0.0046	0.0160	0.0322	0.0178	0.0500
Chrysler "60"	13	55,915	17.16	92.71	0.0040	0.0177	0.0443	0.0203	0.0536
Dodge "4"	69	52,886	15.01	96.62	0.0048	0.0174	0.0351	0.0162	0.0513
Dodge "6" Std	11	30,747	15.32	92.46	0.0033	0.0188	0.0352	0.0183	0.0535
Dodge "6" Victory	10	17,439	15.54	112.88	0.0020	0.0050	0.0190	0.0180	0.0370
Essex Std. "6"	10	9,132	14.29	110.97	0.0011	0.0070	0.0195	0.0123	0.0318
Ford, Model "T"	86	29,348	14.99	99.05	0.0033	0.0171	0.0340	0.0163	0.0503
Ford, Model "A"	158	16,162	17.65	112.30	0.0024	0.0084	0.2270	0.0121	0.0348
Oakland	13	41,723	15.67	113.28	0.0026	0.0136	0.0284	0.0200	0.0484
Pontiac "6"	32	20,416	16.13	100.68	0.0021	0.0098	0.0226	0.0118	0.0344
Trucks									
Chevrolet "4" Light Delivery	33	28,110	13.62	102.15	0.0035	0.0184	0.0356	0.0161	0.0517
Chevrolet "4" 1-ton	109	27,793	9.23	67.92	0.0048	0.0309	0.0556	0.0264	0.0820
Chevrolet "6" 1-ton	49	8,119	10.98	80.13	0.0029	0.0076	0.0259	0.0178	0.0437
Dodge-Graham "4" ¾-ton	56	34,089	12.22	73.50	0.0047	0.0194	0.0400	0.0237	0.0637
Dodge & Graham "6" ¾-ton	33	14,052	11.68	117.34	0.0040	0.0133	0.0333	0.0256	0.0589
Dodge & Graham 1-ton	20	41,517	9.46	61.00	0.0075	0.0265	0.0530	0.0365	0.0895
Dodge & Graham "4" 1½-ton	21	35,785	8.03	47.68	0.0060	0.0341	0.0613	0.0532	0.1145
Dodge & Graham "6" 1½-ton	15	12,732	7.21	61.33	0.0026	0.0136	0.0399	0.0571	0.0970
Federal 1½-ton	12	18,651	6.00	31.10	0.0091	0.0263	0.0662	0.0488	0.1150
Ford Express Model "T"	155	33,419	13.18	73.89	0.0039	0.0153	0.0336	0.0146	0.0482
Ford Express Model "A"	134	14,685	15.40	91.10	0.0022	0.0066	0.0203	0.0101	0.0304
Ford, Model "TT" 1-ton	34	25,906	8.85	40.84	0.0050	0.0264	0.0537	0.0316	0.0853
Ford, Model "AA" 1-ton	17	8,924	10.53	81.39	0.0026	0.0088	0.0285	0.0244	0.0529
F.W.D. Truck 3½-ton	15	7,641	2.39	30.04	0.0124	0.0550	0.1483	0.1085	0.2568
G.M.C. "4" 1½-ton Model K-32	10	33,561	5.96	40.68	0.0109	0.0518	0.0950	0.0631	0.1581
Kleiber 1½-2-ton	28	27,136	6.65	50.49	0.0066	0.0329	0.0652	0.0669	0.1321
Moreland 1½-2-ton	60	24,135	7.67	39.06	0.0050	0.0342	0.0619	0.0677	0.1296
Reo Speedwagon 1½-2-ton	11	17,609	6.93	48.90	0.0054	0.0321	0.0641	0.0488	0.1129

Bridges Offer Many Traffic Hazards

Bad Alignment Locations, Inadequate Guard Railings and Narrow and Slippery Roadways Are Among Most Prevalent Dangers

By O. L. Grover
Principal Highway Bridge Engineer, Bureau of Public Roads, Washington, D. C.

Accident records of 1930 indicate a rapidly mounting list of disasters due to hazards offered by highway bridges. Among these hazards are:

1. Bad alignment in having an angle at the end of a bridge, due in many cases to the location of the bridge on the basis of lowest first cost.

2. Short clear-sight distance on account of an obstruction on the inside of the curve.

3. Short sight distance on vertical curve combined with narrow roadway on bridge.

4. Bridge too narrow for vehicles to pass without reduction of speed and the application of brakes, causing slipping and collision.

5. Low curb and weak rail allowing vehicle to fall over side of bridge.

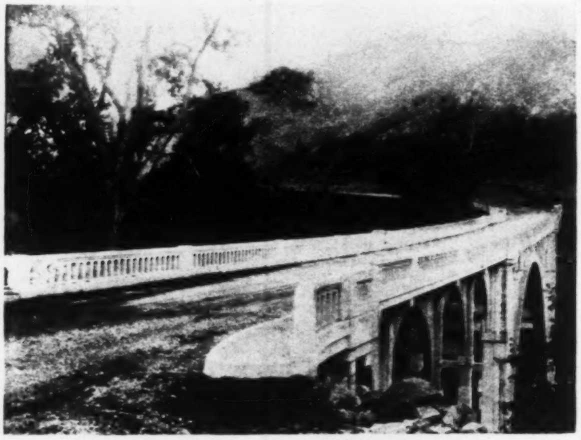
6. Old bridge having insufficient strength for heavy trucks or buses.

7. Bridges so located that road at one end has long descending grade and then has a turn or short curve onto the bridge.

8. Railroad grade crossings and underpass highways divided by piers. For safe driving there should be no obstruction in the road. A highway underpass having a solid pier dividing the traveled way into two or more parts has occasionally been constructed on curves, both horizontally and vertically, and this is particularly hazardous.

The best conditions possible for safety of motor vehicles can be obtained on bridges which are so located that the alignment of the road is straight on the bridge and approaches. The grades should be such that there is good visibility in both directions. Also bridges should be widened as soon as the approaching road is widened.

The bridge having sides or railings adjacent to the traveled way offers an element of danger in passing or meeting vehicles. Anything that prevents the outside car from moving outward to avoid another car restricts the lateral movement and, therefore, may cause the cars to collide. Here the need of care in driving becomes more essential on account of conditions of increased danger found at or near bridges, but not generally existing elsewhere.



Safety Can Be Built Into Bridges

In the structure pictured above heavy rails with wide curbs and flared approaches are definite safety precautions. Entrance to the bridge on a curve at the base of a descending grade is not good practice and should be avoided, however.

Low curbs and weak railings obviously do not give the desired protection. There is a growing tendency to use a strong rail at a height of about 2 ft. above the roadway at the gutter, the preference being for this rail to have a smooth surface exposed to the roadway. On high embankments, and especially on bridges, the side protection should be strong and rigid. The desirable properties in bridge rails are:

1. Good visibility at all times and in all conditions of weather, daylight, sunshine and darkness.

2. Strength sufficient to keep a vehicle from going over the bank or side of structure.

3. Shape, strength and material so proportioned that cars striking it will be diverted into the road as much as possible.

4. Long life with low maintenance cost.

5. A design that will not cause snow to be deposited on the roadway.

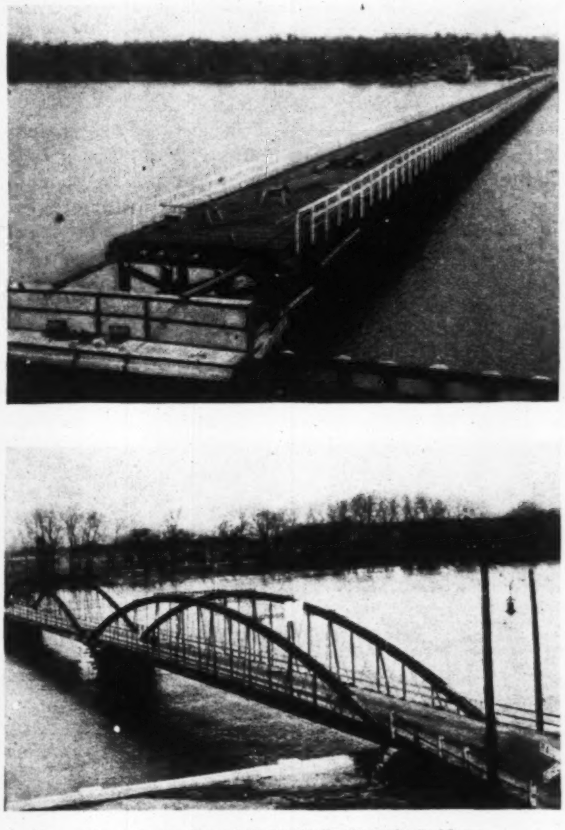
Roadway Width Paramount

In many cases the shoulders outside of the pavement are used to travel upon, and these spaces are really a part of the traveled way. Here the bridge width should include a portion of the width of shoulders. For two lanes of traffic and widths of pavement of 20 ft., the widths of bridges are being made 22 ft. and 24 ft. for traffic which does not include many buses. In locations where there is much bus and truck traffic a bridge width of 24 ft. for two lanes, or at least 30 ft. for three lanes should be used. It has frequently been noticed that drivers manifest a tendency to move toward the center of the road just before entering a bridge to avoid hitting some part of it along the side of the road. However, the fear of hitting the side of that bridge is soon dissipated and the car proceeds a little closer to the curb if two cars meet on the bridge. For the usual two-way bridge the roadway may be widened slightly to overcome the tendency to slow down and move toward the central part of the bridge. This rule, however, should be applied with great care so as to avoid too much reduction of width on bridges that are narrow and are crowded by the traffic.

The following requirements for speeds of from 35 to 45 miles per hour should be given special consideration: Slippery pavements to be avoided, or provision be made to overcome the slipperiness on (*a*) especially bad asphalt or bituminous surfaces, (*b*) steel traffic plates, (*c*) asphalt planks, (*d*) hardwood planks laid parallel to direction of traffic.

It is well to maintain regular widths of traveled way and to move back culvert headwalls, poles, trees and other objects so far as practicable.

Bridges should be inspected at least once each year for strength and general condition, care being taken to provide for the presence of anything which might endanger the structure or be a menace to traffic. Where the bridges are old, the strength of all important parts should be carefully determined by examination of their physical condition. The examination should be separated into two important divisions, one on the basis of new material and having full strength, and the other on the basis of the weakening due to deterioration of the material, erosion of ground and any evidence indicating improper function of members. In the final study the two factors can be assigned a fair value, and combined for use in reaching conclusions. The forces induced by the expansion and contraction of the material cannot be overlooked.



Two Examples of Potentially Unsafe Bridges

The railing of the structures shown at the top would not prevent a car from going into the water. Old bridges, such as shown in the lower picture, are unsafe because their floor systems and truss bracings are usually too light to meet the demands of modern traffic.

In steel truss bridges the first serious overloading by moving loads usually overtaxes the floor system, stringers, floor beams and hangers while dense traffic, where two or more heavy vehicles or continuous lines of vehicles are on the same span at the same time, may induce unsafe stresses in truss members.

Light-weight and narrow-truss bridges are sometimes injured by trucks or automobiles striking them. Compression truss members in old bridges were very weak in the details intended to hold the two or more parts in the proper position and in straight lines so that they could resist stresses of appreciable size. Some of the trusses in highway bridges built from 40 to 60 years ago have compression members which should not be trusted to carry the stresses liable to be produced in them by modern heavy trucks and buses.

Special Hazards Summarized

1. Poor alignment of road on and adjacent to a bridge.
2. A profile having vertical curves and grades affecting sight distance.
3. Combinations of horizontal and vertical curves.
4. Too short sight distance due to obstructions along the side of the traveled way.
5. Slippery pavement.
6. Irregular crown and banking of road surface at curves.
7. Permanent obstructions in road.
8. Intersecting highways near or on bridges.
9. Visibility of bridges, railings and warning signs.

Traffic Congestion Problems

IN THE final action of the recently held National Conference on Street and Highway Safety appeared a set of typical problems bearing on the relief of traffic congestion which require research and experimentation. Secretary Lamont was requested to appoint a committee to consider ways and means of establishing a national non-governmental foundation to conduct comprehensive studies of such problems of congestion affecting public safety, the stability of property values and the orderly development of urban communities as are indicated in the following list.

1. The relation between traffic and transit conditions and facilities, and the trends in centralization or decentralization of cities.
2. Factors to be considered in determining the relative advantages and cost of possible programs of increasing street capacity.
3. Comparative advantages and cost of widening radial traffic arteries from a central business area, and the construction of bypass routes to relieve that area of traffic not destined thereto.
4. Relationship of building bulks and intensity and character of lot occupancy to traffic density and transportation requirements.
5. Comparison of various street intersection designs, existing or proposed, with respect to traffic facilitation, safety and cost.
6. Relation among automobile speeds, street capacity and accidents.
7. Effective traffic capacity per lane of highways of various widths and characteristics.
8. Effect of standardization of traffic regulations upon accidents, speed and street capacity.
9. Factors which should determine public policy with respect to railroad or highway grade separation.
10. Principles which should guide in planning public transportation facilities as part of a city plan.
11. Effect of various types of traffic control, and particularly signals, upon the capacity of streets, the movement of traffic and public safety.
12. Factors to be considered in planning express parkways, main traffic highways or superhighways in the residential environs of metropolitan areas.
13. Economic relationship of street and highway lighting to traffic facilitation and safety.
14. Characteristics of various types of pavements and effects of defective pavements in relation to traffic capacity, speed and accidents.

Hints and Helps in Highway Testing

A Group of Articles Describing Methods and Appliances in Use in Various State Highway Departments

PENNSYLVANIA

Temperature and Humidity Control in Cement Testing

By H. S. Mattimore

Engineer of Tests and Materials, Harrisburg, Pa.

HIGH-STRENGTH cement, especially the product termed "high-early-strength cement," is more sensitive to temperature and humidity conditions during testing than the cement produced several years ago. Specifications allow a tolerance of plus or minus 5 per cent. In some cases this tolerance is too broad, as conditions have been experienced in testing high-early-strength cement where a maintained temperature of 65 deg. resulted in rejection on strength requirements, whereas these requirements were met when a temperature of 70 deg. or over was maintained.

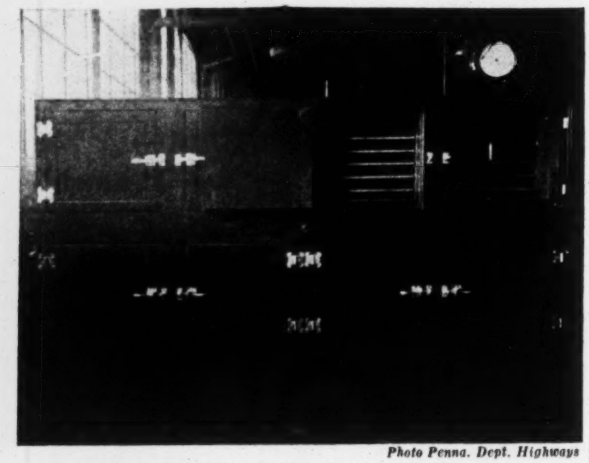


Photo Penna. Dept. Highways

Moist Air Cabinet for Specimens

In regard to humidity, the standard specification requires that during storage of the strength specimens the relative humidity in the moist closet shall not be less than 90 per cent. Efforts are made by many laboratories to maintain humidity from 95 to 98 per cent. Great care has to be taken in the method to control this relative moisture percentage in order to avoid an excess, thereby causing precipitation which has been found harmful to some test specimens during early periods of hydration. Moist air sprays, if not carefully controlled, are likely to cause precipitation or condensation of moisture on the test specimen.

In the Pennsylvania department of highways testing laboratory the special moist air cabinet is constructed with slate interior, 1 in. of cork insulation and steel exterior. The humidity is maintained from 95 to 98 per cent by means of running water flowing from perforated pipes in each section down the sides of a brass mesh screen mounted about $\frac{3}{8}$ in. from the side walls. The temperature of the running water is regulated in temperature-control valves prior to entering the cabinet. This combination of constant running water maintained at a constant temperature in an insulated cabinet has given very efficient results, as temperature records over many weeks indicate a maximum variation of 2 deg. from 70 deg., generally on the plus side. Even this small variation only occurs for short periods. Humidity determination has also shown a control from 95 to 98 per cent through several weeks' trial.

The moist closet illustrated consists of eight independent units, each unit containing two doors. This separate unit division is quite important so that the periodic openings of doors in one unit will not affect temperatures in other parts of the cabinet.

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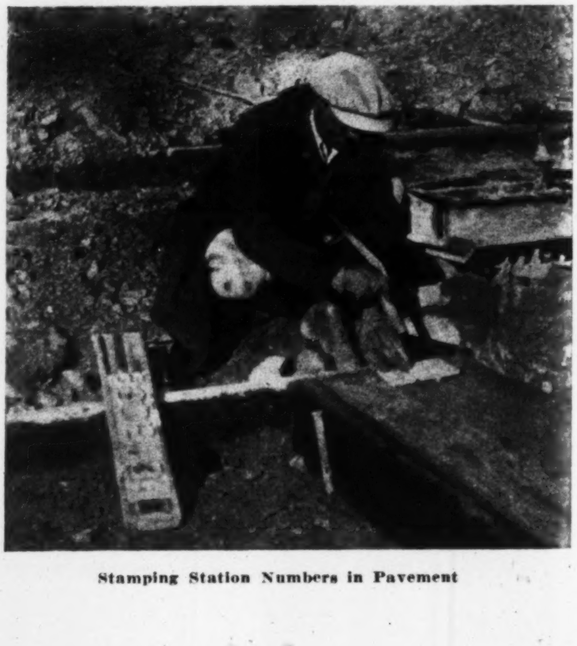
TENNESSEE

Station Numbers Stamped on Pavement

By E. W. Bauman

Engineer of Tests, Department of Highways, Nashville, Tenn.

ALL pavement laid by the Tennessee highway department during the past three seasons has been identified by having the station numbers imprinted in the concrete before it sets up. Each project is furnished a set of numerals and every 500 ft., starting from the zero end near the right edge of the pavement, the slab inspector imprints the stationing. The station at which the end of each day's pouring occurs is also imprinted. With this arrangement and the aid of the engineer's diary any research work applying to a project in later years can be directly tied up with conditions obtained



Stamping Station Numbers in Pavement

under construction, such as temperature, humidity and materials.

In making crack surveys, by the ready reference to stationing afforded by this method much time is saved, and accuracy in results is effected. Maintenance engineers also find these references helpful in directing their crews in repair work.

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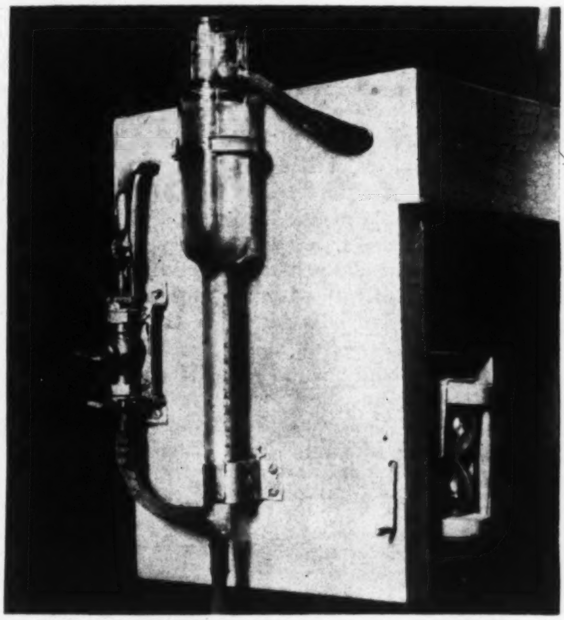
MISSOURI

Automatic Burette for Measuring Mixing Water

By F. V. Reagel

Engineer of Materials, State Highway Department, Jefferson City, Mo.

AN AUTOMATIC burette has been successfully used for four years in the Missouri State Highway laboratory to replace the cylinder method of measuring mixing water for cement mortar briquets. A desirable feature is that all measurements are made at the same eye level.



Burette for Briquet Mixing Water

The burette is constructed of glass, the total length being 30 cm. The top section is approximately 4 cm. in diameter and the graduated measuring stem is drawn from this section. The top part is calibrated for 100 c.c. and the stem is calibrated and graduated at 20 deg. C., in cubic centimeters by 0.5 c.c. The top section is sealed at the upper end with a glass cap having a small tubular outlet, opening to the overflow chamber. An 8-mm. tube is sealed to the wall of the overflow chamber and is connected to the drain by a rubber tube. The end of the graduated stem is drawn to approximately 8 mm. diameter. A rubber tube connecting to the lower end of this stem leads to the point where the mixing water is to be used. The rubber tube is closed by a pinchcock to facilitate easy operation. An 8-mm. glass tube is sealed to the graduated stem at a point below the last graduation. A rubber tube is connected at this point to the reserve source of mixing water. A petcock is placed in this line and is located within easy reach of the operator.

The operation of this burette is very simple, the operator merely having to open the petcock which is in the reserve mixing water line and the burette is filled through the lower end of the graduated stem. This filling can take place while the operator is mixing a batch of mortar. The filling is complete when the water flows through the tubular opening to the overflow chamber. The petcock is then closed and the operator opens the pinchcock in the draw line, observing on the graduated stem the volume of mixing water desired. The burette is accurate as used to approximately 0.25 c.c. One burette will supply water to two operators mixing at the same time.

The support for the minute glass is another desirable feature. This allows the glass, which is used to control the mixing time, to be observed at the operator's eye level. A half turn of the small crank resets the minute glass for the next operation.

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MICHIGAN

A Percentage Balance for Concrete Aggregates

By W. J. Emmons

Director State Highway Laboratory, Ann Arbor, Mich.

IN 1927 the Michigan state highway laboratory felt the need of a type of balance which could be used in making a rapid determination of the grading of concrete aggregates and which could be employed at those plants where it was required to inspect more than 30 cars of aggregates per day. The percentage balances on the market were not adapted to the size of samples which the laboratory required, and they were not suited to handling more than one size of samples.

With the help of a local scientific instrument shop, an agate-bearing balance which has a capacity of about 13 kg. and which was sensitive to 1 gram was altered to meet the requirements. Two scale arms were made with graduations from 0 to 100, with the smallest division 1 per cent. Sliding poises were constructed so that 5 kg. of coarse aggregates could be measured with one arm and 500 grams of sand with the other. A pan 13½ in. in diameter and 2½ in. deep was built, together with a spindle for holding the pan. This size pan was required to hold the entire sample of coarse aggregate at one time.

The percentage of material passing each screen can be

Percentage Balance for Aggregates

read directly from the scale arms and no computations are necessary. The scales are read to the nearest 1 per cent, which is close enough for work of this kind. The grading of a sample of coarse aggregate can be obtained in about four minutes, while that of sand can be completed in approximately ten minutes. It has been established that, by the use of this device, it was possible to dispense with the aid of an extra man at plants where it was necessary to inspect aggregates up to a maximum of 50 cars per day.

The average cost of each balance was about $50. The laboratory at present has nine of them; three were originally purchased in 1927, and six more were made up in 1930. A special equipment case was built to house the apparatus and when in transit a split rubber cork is inserted under the spindle, which raises the knife edge off the agate bearings and thus protects them from sudden jars.

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CALIFORNIA

Improved Asphalt Extractor

By T. E. Stanton
*Materials and Research Engineer,
California Division of Highways, Sacramento, Calif.*

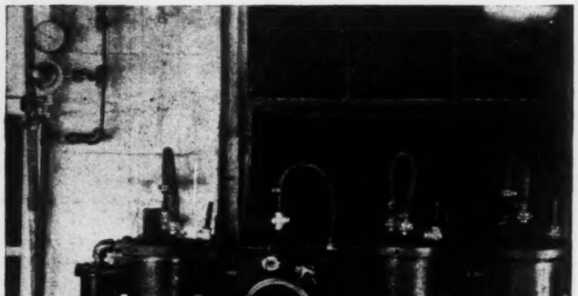
To overcome some of the objectionable features of the standard asphalt extractors, a new type of extractor using compressed air has been recently developed at the California state materials and research laboratory.

The extractor consists of a piece of $5\frac{1}{2}$-in. inside diameter iron pipe 7 in. long mounted on an iron frame. The top of the pipe is closed with a solid iron cap, screwed on, and the bottom with a 1-in. thick alundun filter stone held in place by a steel ring cap.

Extra solvent and compressed air for forcing the solution of solvent and asphalt through the filter stone are admitted through orifices near the top of the cylinder. The cylinder is mounted on trunnions so as to permit it to be tipped forward and emptied of the aggregate when the extraction is complete. The minus 200-mesh material is not carried through the stone. An air pressure of 90 lb. is used.

Chloroform is used as a solvent, approximately 85 per cent of which is recovered, thus making the cost of th solvent 13c. per sample.

The extractor was first constructed and put into service in May, 1930. A large number of prepared sampl were run to determine the accuracy of the metho Eleven of the more difficult samples containing a hig percentage of 200-mesh material and asphaltic cement showed a maximum variation of 0.2 per cent between th asphalt content used and extracted, with an average variation for the eleven samples of less than 0.03 per cent The time of extraction with oil or asphaltic concret mixtures is from 15 to 30 minutes.



A New Asphalt Extractor

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ARIZONA

Testing Oil-Carrying Quality of Earth

By J. W. Powers
*Engineer of Tests, Arizona Highway Department,
Phoenix, Ariz.*

The proposed material, graded to specifications, is mixed with what is considered sufficient oil (asphaltic residue 65 per cent plus by the Brown evaporator) and allowed to stand overnight for absorption. That portion passing a 10-mesh sieve is hand-tamped into a circular mold (3 in. diameter and 2 in. deep) and is further compacted by applying a load of 2,000 lb. per sq.in. (load applied by means of a universal testing machine). Pressure is applied to the material by means of a die cut to fit the mold, and the material is pressed against a face plate so as to bring it flush with one end of the mold. The bottom is sealed with paraffin, after which the whole apparatus is immersed in water.

Any appreciable swelling above the original plane at the end of twelve hours or more is evidence of instability with oil. The datum plane for measurement is the top of the ring, and $\frac{1}{16}$ in. has been tentatively set as the maximum amount of swell which a material may have that is considered safe to use.

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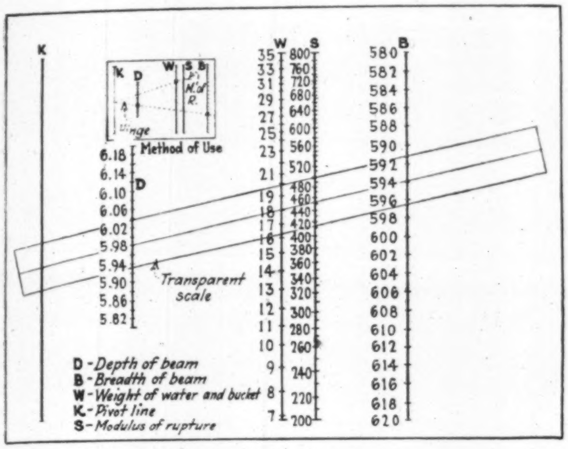
KANSAS

Modulus of Rupture Determined By Graphics

By L. H. Koenitzer
*Instructor in Applied Mechanics, Kansas State College,
Manhattan, Kan.*

Rapid graphical determinations of modulus of rupture in beam tests with the Iowa type of beam-testing machine are possible in field or laboratory by the ruler and scales shown by the accompanying drawing. With the Iowa machine 6x6-in. beams are tested with spans of 18 in.

The graph is printed on $8\frac{1}{2}$x11-in. paper. A piece of celluloid with a straight line scratched on it is used as a straight-edge. If the breadth of the beam is 5.94 in. and the depth is 5.98 in. the straight-edge is placed over these values marked on scales *B* and *D* respectively. By placing the point of a sharp pencil in a hole falling on scale *K* in line with the values of *B* and *D* the celluloid straight-edge is pivoted until the line intersects the value on scale *W* which represents the breaking weight in



Modulus of Rupture Graph

pounds. In the illustration the straight-edge is set on scale *W* at 18 lb., which gives a modulus of rupture of 455 lb. per sq.in. The graph can be read to the closest 2 lb., which is sufficiently accurate for tests on concrete, the error being in most cases less than 0.5 per cent.

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WISCONSIN

Rocker Screen Speeds Up Field Test Operations

By C. R. Stokes

Materials Engineer, Wisconsin Highway Commission, Madison, Wis.

The screening aggregates in test-pitting and in controlling concrete mixtures, can be expedited by the rocker screen shown in the accompanying illustration. Both wood and metal screen boxes are used. The wood set, $16\frac{1}{4}$x$16\frac{1}{4}$ in., is for samples up to 50 lb.; the steel set about 12 in. square, has a capacity of 25 to $33\frac{1}{3}$ lb.

The wood set consists of the rocker section and four bottomless boxes accommodating the various sized steel screen plates. The rockers are sawed from 2x4-in. stock; the boxes are made from 1-in. white pine finished on four sides and secured with screws. On all four sides of the boxes, except the top section, $2\frac{1}{2}$x5x$\frac{3}{16}$-in. steel plates are bolted to the upper portion. The upper 2 in. of the plate projects above the top of the box, acting as a holder for the section above. Also the top $\frac{1}{2}$ in. of the plate is bent outward $\frac{1}{8}$ in. to facilitate fitting the sections together. Wood strips, $\frac{3}{8}$x$\frac{1}{2}$ in., are screwed to the inside of each frame at the bottom to serve as a screen rest. The screen plates are cut $14\frac{1}{2}$x$14\frac{1}{2}$ in., allowing approximately $\frac{1}{8}$ in. on each side for ease in fitting them into the frames. The screens are held in place by means of screwbolts with square heads.

Rocker Screening Set for Aggregates

The metal set consists of a wooden rocker and box section, metal bottom pan and metal frames fitted with the necessary screens. The screen frames are made to telescope, the bottom pan being 12 in. square and each succeeding frame $\frac{1}{4}$ in. smaller in square dimension. Metal shelves are set $\frac{3}{4}$ in. below the top of the bottom pan and screen frames, to furnish support for the frame above. The frames are 18-gage metal and the screens 16 gage. The screens are secured to the frames by stove bolts to permit the use of different sizes depending on the gradation requirements.

Either of these screen sets has a decided advantage over the usual method of hand screening. By hand, an adequate sample must be sifted three or four times, whereas with the rocker set one sifting process will usually suffice. It is estimated that it takes about half as long to screen a sample with the rocker set as it would were the hand method and individual screens used.

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ILLINOIS

Section Area of Steel Measured by Weighing

By V. L. Glover

Engineer of Materials, Division of Highways Springfield, Ill.

A great majority of concrete reinforcement bars are so irregular in shape that their areas cannot be determined accurately by direct measurement with the ordinary micrometer calipers. By the method described herein the area is computed from the weight and length of the tensile specimen. The method is quick and gives precise results, and can be carried out in any laboratory or mill where the usual testing facilities are available.

The apparatus required consists of one balance of 5-kg. capacity and sensitive to $\frac{1}{2}$ gram; one set of metric brass weights from 4 kg. down to 1 gram, and one 24-in. steel rule graduated in one-hundredths of an inch.

The determination is made on the tensile specimen cut to the proper length for testing, usually about 18 in. The length of the specimen is taken to the nearest 0.05 in., the bar weighed to the nearest 0.5 gram, and the length and weight recorded. The area is computed according to the following formula:

$$Area = \frac{0.0077737 \times Weight\ in\ grams}{Length\ in\ inches}$$

The method is directly applicable to plain bars and deformed bars having projecting ribs or lugs; the weight of the metal forming the lugs must be determined and deducted from the original weight of the test bar. In routine inspection, standard correction factors can be used for such bars.

NEWS OF THE WEEK

Failure of Corpus Christi Dam Laid to Underflow

Excessive percolation of water through the underlying lenticular beds of silt, sand, gravel and clay upon which the Corpus Christi water-supply dam rested is given as the cause of its failure on Nov. 23 in the preliminary report of the engineers engaged by the city council to investigate the failure. The fact that the steel sheet pile cutoff wall under the dam was not driven down through the lenticulated strata to the underlying bed of clay was given as the reason why the underflow occurred. The final report of the engineers is expected about Feb. 1.

A description of the conditions at the dam following its failure was published in our issue of Dec. 18, 1930, p. 974.

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Plans Being Prepared for Cle Elum Dam

Plans and specifications for the construction of Cle Elum dam, the sixth and last of the series forming the water-storage system of the Yakima reclamation project in Washington, are being prepared by engineers of the U. S. Bureau of Reclamation. It is stated by the bureau that bids will be called for immediately after the specifications are ready. An appropriation of $15,500,000 is available and it is hoped that construction can be started in the spring.

The dam, which will be on the Cle Elum River near Ellensburg, Wash., will be 125 ft. high and 700 ft. long. It will form a reservoir of 4,680 acres, in which will be stored 435,000 acre-ft. of water.

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State Capitol of North Dakota Destroyed by Fire

Fire razed North Dakota's state Capitol at Bismarck on Dec. 28 with a monetary loss of about $1,000,000 and an incalculable loss of state records and documents. The building, of brick and frame construction, was built in three sections in 1885, 1894 and 1904. Plans had already been made for the construction of a new building. The state highway department, occupying a major share of the top floor of the old building, lost profiles and plans for work that will cost from $200,000 to $300,000 to reproduce. Records which cost hundreds of thousand of dollars to compile were lost by the railroad board. Temporary state offices will be set up in various public and private buildings in Bismarck. The legislature, which convenes Jan. 6, will meet in the new World War Memorial Building.

Advance Figures for Public Works to Be Undertaken in 1931

RETURNS received during the week evened considerably the estimated totals for the country's public-works construction of 1929-30. The present estimate, based on the returns to date, is as follows:

1929	$3,236 000,000
1930	3,469,000 000
1931	3,400,000,000

Revised estimates will be published in subsequent issues based on more complete returns.

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To Fight I.C.C. Control of Water Lines and Motor Vehicles

An organization to be known as the Water Lines and Motor Vehicles Association of the United States has been formed to fight legislation designed to place inland and coastwise water lines and motor vehicle lines under the control of the Interstate Commerce Commission. The organizers maintain that inland water and motor vehicle lines will be hampered in their efforts to give inexpensive service if subjected to control of the commission.

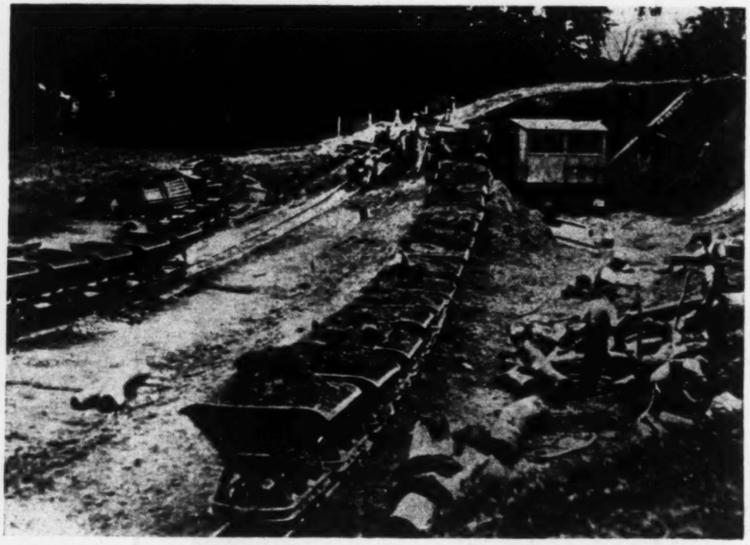
$80,000,000 Federal Road Fund Apportioned to the States

Arthur M. Hyde, secretary of agriculture, has apportioned to the state $80,000,000 for immediate use in federal aid road construction, as provided i the act approved Dec. 20, providing fo emergency construction to increase employment. Apportionment was als made of $3,000,000 for building road on public lands to be administered b agreement, either by the states or b the Bureau of Public Roads.

According to provisions of the emergency legislation, these funds are to b used by the states in place of state funds to match regular federal-aid funds previously authorized and apportioned. On Nov. 30 the federal-aid funds available to the states for new projects amounted to $155,383,877. Since each state had to its credit an amount at least equal t the sum now made available, it will b possible to spend $160,000,000 in road work without providing any money from state sources.

The federal government is now prepared to advance the full cost of projects submitted under the emergency legislation. The sums advanced to the states from the $80,000,000 appropriation are to be reimbursed to the federal government over a period of five years, commencing with the fiscal year 1933, b making deductions from the regular

BYPASS ROAD CONSTRUCTION IN ENGLAND



Congestion due to through traffic attempting to get through crowded city streets is an important highway problem in England as here in this country and is being met in much the same way. The bypass road shown under construction is at Colchester, Essex, England. Modern excavators are used, but hand work in switching the cars is still in evidence.

apportionments of future federal-aid authorizations. Should any state fail to claim any part of its allotment, the President may reapportion the unclaimed funds to states capable of using them prior to Sept. 1.

The apportionments follow:

State	Sum Apportioned	State	Sum Apportioned
Alabama	$1,698,645	New Jersey	$1,107,807
Arizona	1,170,481	New Mexico	1,303,288
Arkansas	1,388,157	New York	4,050,566
California	3,108,233	No. Carolina	1,926,775
Colorado	1,507,832	No. Dakota	1,298,532
Connecticut	520,491	Ohio	2,998,538
Delaware	400,000	Oklahoma	1,926,351
Florida	1,086,438	Oregon	1,320,287
Georgia	2,077,996	Pennsylvania	3,512,943
Idaho	1,008,035	Rhode Island	400,000
Illinois	3,400,116	So. Carolina	1,114,636
Indiana	2,045,929	So. Dakota	1,337,973
Iowa	2,116,369	Tennessee	1,741,882
Kansas	2,192,301	Texas	5,088,080
Kentucky	1,504,715	Utah	926,521
Louisiana	1,147,927	Vermont	400,000
Maine	715,799	Virginia	1,505,502
Maryland	678,752	Washington	1,270,938
Massachusetts	1,141,460	W. Virginia	875,384
Michigan	2,521,382	Wisconsin	1,992,410
Minnesota	2,249,993	Wyoming	1,029,383
Mississippi	1,434,736	Hawaii	400,000
Missouri	2,526,823		
Montana	1,671,930		
Nebraska	1,708,031	Total	$80,000,000
Nevada	1,049,638		
N. Hampshire	400,000		

The $3,000,000 for building roads on public lands has been apportioned as follows:

State	Sum Apportioned	State	Sum Apportioned
Arizona	$418,438	Oregon	$194,357
California	231,782	S. Dakota	66,048
Colorado	130,857	Utah	328,338
Idaho	175,199	Washington	55,445
Montana	165,355	Wyoming	282,339
Nevada	591,898		
New Mexico	258,091		*$2,925,000
Oklahoma	26,853		

*$75,000 deducted for administering the funds.

◆

San Diego to Receive More Power From Hoover Dam

Secretary of the Interior Wilbur has announced that 90,000,000 kw.-hr. energy to be generated annually at Hoover Dam had been allocated to the city and county of San Diego. This energy, which is over and above the 4,240,000,000 kw.-hr. originally allocated, was made available by the increased water level authorized by the Sibert board. The city of Los Angeles had also filed an application for this additional energy, but after conference with the city of San Diego, in which San Diego's need for this energy for pumping domestic water was asserted, Los Angeles interposed no objection to allocation of the full amount to San Diego. The energy will be generated at cost by Los Angeles, but the capital cost of the generating equipment acquired will be borne by San Diego. Transmission will be subject to independent negotiations between San Diego and other parties. The energy is allocated for municipal purposes and distribution to the city's inhabitants directly or under contract.

Negotiations of contracts with the eleven municipalities which share the 6 per cent allocation announced in March is proceeding in Los Angeles with the district counsel of the Bureau of Reclamation. San Diego's representatives will proceed to Los Angeles to negotiate their contract along the general lines of the contracts of the other municipalities, with certain differences on account of the different character of the allocation and different generating and transmitting problems.

By including San Diego in the allocation of Hoover Dam energy this power is now shared by three states, thirteen cities and the Metropolitan Water District of Southern California.

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Natural Gas From Canada to Be Piped Into the United States

Importation of natural gas from Alberta into the United States will soon begin, the new pipe line from the Rogers-Imperial well east of Coutts to the international boundary having been completed. In a short time Great Falls, Mont., will be receiving gas from Alberta, which will run through the 7-mile pipe line from the gas well to the Montana border and connect with the lines of the Montana Cities Gas Co. It is expected that the gas will be piped into other Montana towns as soon as arrangements can be made.

To Investigate Extension of Los Angeles' Power Plant

E. F. Scattergood, chief engineer of the Los Angeles bureau of power and light, has been instructed by the board of water and power commissioners to proceed with an investigation of the proposed development of the city's power plant No. 2 in San Francisquito canyon.

A resolution of the commission pointed out that the board of consulting engineers, employed at the suggestion of the Los Angeles Chamber of Commerce preceding the unsuccessful power bond election of Nov. 4, had reported that a third generating unit could be added to power plant No. 2 at a cost of about $950,000 and would return a net profit of about $125,000 annually.

The board's resolution directed Mr. Scattergood to investigate and report on this recommendation and to look into the power needs for the next two years and determine what saving on the amount paid to the Southern California Edison Company, Ltd., for power might be expected with the construction of the proposed new unit.

New York Rapid Transit Unification to Cost City $490,000,000

Plan Proposed Calls for Actual New Municipal Outlay of $161,730,000—Rejection by Operating Companies Means Recapture of Various Lines by City—Five-Cent Fare Maintained

With municipal operation on New York City's independent subway system, parts of which are rapidly nearing completion, imminent unless consolidation with existing lines can be made, Samuel Untermyer, special counsel for the city, has submitted a plan to the New York transit commission for the unification of all rapid-transit systems. The total cost to the city would be $489,804,000, of which $161,730,000 would be new outlay, the remainder represented by municipal funds already tied up in the transportation lines. Two companies, the Brooklyn-Manhattan Transit and the Interborough Rapid Transit, are now operating a total of 215.1 route-miles of rapid-transit lines. These companies have leased 118.7 miles of city-owned lines in addition to operating their own lines, 96.4 miles long. The new subway system now under construction will add 55 miles of lines. The city has the right to recapture all lines leased to the operating companies.

Mr. Untermyer recommends a board of transit control to be authorized by the state legislature, the board to be capable of issuing bonds in its own name and handling the financing of the consolidated system. The plan further calls for a contract with the present B.-M.T. operating organization for the management and operation of the unified lines for a compensation of $200,000 yearly. The independent municipal lines would be organized as a separate corporation to be a subsidiary of the board of transit control and carried under a separate accounting system.

Threat of recapture is the alternative offered by the city should the present operating companies reject the plan. Recapture of the city lines now run by the I.R.T. would throw that company into receivership, according to the report. The plan would cancel existing dual contracts between the city and operating companies and would recover $386,050,000 now "frozen" in the city's investments in the private properties, releasing this amount from the debt limit of the city. Estimates show that the present five-cent fare could be maintained at a profit to the city. One of the reasons given for incorporating the city's subway lines separately is that should a five-cent fare be insufficient to meet fixed charges and operating expenses, the earnings of the entire unified system would not be impaired.

The first report of unification was made in September, 1927. It was supplemented by another report in July, 1928, with which was presented a unification plan worked out in agreement with the B.-M.T. The I.R.T. at that time refused to enter into negotiations with the city.

Only One Bid on Sewage Plans for San Diego

Only one bid was received by the city of San Diego, on Dec. 22, for furnishing plans, specifications and cost estimates for collecting and delivering "all the sewage of the city" to sites to be shown on maps submitted by the bidders. (See *Engineering News-Record,* Dec. 11, 1930, p. 942, for a report of the official call for bids and a statement of protests to the city against such action, and p. 913 for editorial comments adverse to the call.) The single bid received was an offer from F. W. Seifert, reported in the San Diego *Union* as an offer "to furnish a sewage-disposal plan for $18,000."

The *Union* also states: "Seifert is now negotiating with the city on a plan to dispose of the city's sewage in return for reclaimed water from the sewage," the city to "deliver the sewage to specified treatment plants" and the plant effluent to be "used in irrigation." It appears that this disposal offer was before the city authorities when they decided to issue the call for bids for collection and delivery plans. Two days before the opening date, in the course of a story embodying the editorial already mentioned, the *Union* stated that "several engineers" had indicated their intention to submit bids, "while a vastly larger number" had announced they would not do so "because the bid call is unethical" and also because, in the absence of specifications, there would be "no way to compare bids." The *Union* also stated that "protests" against the call had been received "from several engineering societies."

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Progress Reported on St. Lawrence Power Development

The St. Lawrence Power Development Commission, appointed by act of the legislature of New York, has returned to the United States from a conference in Canada with the Hydro Electric Power Commission of Ontario and expresses satisfaction with the progress made toward an agreement on development of the river's power resources. The New York commission will make a report to Governor Roosevelt and the legislature on Jan. 15.

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Estimated Expenditures on State Highways in 1931

Information received by the manufacturers division of the American Road Builders Association from 48 states on estimated expenditures for state highway construction and maintenance for 1931 indicates that $840,850,000 will be spent. The legislatures of more than 40 states meet in 1931 and general sentiment favors increasing funds for highway operations, not only for the relief of unemployment but because urgent necessity exists for more connecting highways and the relief of traffic congestion. Under the circumstances it is probable that the various state legislatures will pass bills materially increasing the amount of funds for highways.

The expenditures for 1930 on county and township highways estimated by the U. S. Bureau of Public Roads was $664,000,000, and while there is no estimate available for 1931, it is probable that the 1930 figure will be increased somewhat to satisfy a fast growing demand for improved farm roads and for the relief of unemployment.

The amount expended on state and county roads in 1929 was $1,700,000,000 and in 1930 it was $1,600,000,000 (estimated). It is probable that this total may reach $2,000,000,000 in 1931.

The following table lists the estimated expenditures on state highways in 1931. The information was submitted by the various state highway departments. Because of the probability of favorable legislative action on highway expenditures by most of the state governments and by Congress next year, there is a likelihood of these figures being increased.

State	Total	State	Total
Alabama	*$15,900,000	Nebraska	$10,000,000
Arizona	6,500,000	Nevada	3,000,000
Arkansas	15,000,000	N. Hampshire	5,500,000
California	30,000,000	New Jersey	36,000,000
Colorado	5,000,000	New Mexico	*5,650,000
Connecticut	12,600,000	New York	60,000,000
Delaware	2,200,000	N. Carolina	11,000,000
Florida	12,000,000	N. Dakota	3,500,000
Georgia	18,000,000	Ohio	34,000,000
Idaho	5,500,000	Oklahoma	16,000,000
Illinois	*31,600,000	Oregon	10,000,000
Indiana	24,000,000	Pennsylvania	60,000,000
Iowa	30,000,000	Rhode Island	4,300,000
Kansas	*13,700,000	S. Carolina	22,500,000
Kentucky	20,000,000	S. Dakota	6,000,000
Louisiana	30,000,000	Tennessee	12,000,000
Maine	13,100,000	Texas	45,200,000
Maryland	11,000,000	Utah	4,000,000
Massachusetts	20,000,000	Vermont	5,100,000
Michigan	30,000,000	Virginia	17,000,000
Minnesota	15,000,000	Washington	*12,500,000
Mississippi	6,000,000	W. Virginia	14,400,000
Missouri	33,500,000	Wisconsin	33,000,000
Montana	*4,500,000	Wyoming	5,000,000
Total			$840,850,000

*No estimate returned. Expenditure dependent on legislative action. 1929 figures used.

The Business Outlook

Holiday business seems to be in fair volume, but the trade indicators are confused by abnormal shifts of currency and bank funds accompanying withdrawal of deposits and closing of banks due to popular hysteria in some sections. Building contracts are holding up surprisingly well for the season. Merchandise carloadings also are declining more slowly than usual at this period. Industrial activity is slackening rapidly, as it usually does in the last two weeks of the year, with holiday and inventory shutdowns; but a fair amount of forward buying of steel and copper at firm prices strengthens the promise of a first of the year upturn. The return of strength to the bond market is the most encouraging event of the past week.

—*The Business Week, Dec. 31.*

To Observe Local Wage Scales on Public Works

In announcing that the total expenditure by the federal government for public works during the calendar year 1931 will be $724,058,000, President Hoover let it be understood that the government will insist that contractors on the work shall observe the prevailing wage scales in the various sections and communities. This is in accordance with the more restrictive policy favored by the Senate in attempting to insert an amendment in the $116,000,000 emergency construction bill stipulating that local wage rates be paid in all work done under the terms of the measure. This amendment, however, was taken out upon the insistence of the House. It is pointed out that the President has preserved the spirit of the amendment but has left out its restrictions.

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Power From Rock Island Project Expected by Nov. 1, 1931

Power from the Rock Island hydro-electric development on the Columbia River near Wenatchee by Nov. 1, 1931, is the plan of the Washington Electric Co., according to Leslie R. Coffin, manager. This company is a subsidiary of the Puget Sound Power & Light Co. Work on the dam is more than nine months ahead of schedule. With the beginning of the new year the 880-ft. power house now under construction and the spillway adjoining it in the east channel of the river attained a height beyond the water level. This will permit removal of the cofferdams and their reconstruction in the west channel of the river early this spring, which will allow the permanent dam in the west channel to be built next fall. Stone & Webster are building the project.

◆

Los Angeles to Acquire Water-Bearing Lands

Announcement of a policy of acquiring water-bearing lands for the aqueduct extension in the Mono basin by condemnation proceedings rather than by negotiation with the owners was made Dec. 23 by Mayor John C. Porter, of Los Angeles, Calif. The Mono basin is the city's principal source of water supply, and is at the head of the Los Angeles aqueduct.

The Los Angeles city attorney has announced that one suit, with about 90 defendants, has been filed and service is being made upon these land owners as rapidly as possible. The city council has requested the California railroad commission to make an appraisal of the value of water rights of the Southern Sierras Power Co. in the basin.

Money for the purchase of lands is to come from a $38,800,000 bond issue approved by Los Angeles voters for extension of the aqueduct.

Brief News

Creation of a city planning commission in Lansing, Mich., which has been under consideration, has been rejected by the city council.

A Gift of $52,500 to the New York State Conference of Mayors and Other Municipal Officials from the Spelman fund of New York is announced. The money is to be used during the next six years for studies of state-wide practical problems of municipal administration and for increasing the technical competence of administrative officers and employees through training schools or other methods of technical instruction and guidance.

Bids Will Be Invited soon for 900 miles of hard-surfaced toll roads in Argentina between Buenos Aires and Cordoba and between Buenos Aires and Bahia Blanca. The constructing company will be permitted to collect tolls covering interest on the cost of construction, with the government annually making up any deficit, while any surplus must be returned to the government, the idea being to construct the two roads without expenditure of government funds.

To Report on Rebuilding Burrard Inlet Bridge

A royal commission of engineers has been appointed to investigate and determine the best method of rebuilding the Second Narrows bridge over Burrard Inlet at Vancouver, which was destroyed on April 24 as the result of a vessel colliding with the structure, as noted in *Engineering News-Record*, May 8, p. 785. The commission consists of L. E. Cote, chief engineer of the department of marine; E. Bryden Jack, district engineer of the department of public works at Vancouver, and C. E. Cartwright, engineer, Vancouver.

Puget Sound Co. Sets Budget of Nearly $21,000,000

Continuance of the expansion program of the Puget Sound Power & Light Co., Seattle, Wash., is announced. During 1931 the company will spend nearly $21,000,000, inclusive of construction costs, operation and maintenance, taxes, and local dividends and interest. Construction plans to be carried out include expenditures totaling $10,310,000. Most of this amount is for power plant, transmission and distribution system costs. In 1930 these items aggregated $12,201,000; for 1931 the total is $9,308,000. For carrying on work at Rock Island $6,755,000 is allotted, and for the transmission line over the Cascades from Rock Island $847,000, bringing the total to be expended on that hydro-electric project to $7,602,000.

McNiven Made Chief Engineer, Port of New Orleans

James J. McNiven has been appointed chief engineer of the Port of New Orleans by the board of commissioners. Mr. McNiven has been principal assistant to the chief engineer of the port since 1920. Mr. McNiven succeeds the late Samuel McCain Young, who was chief engineer of the port from 1921 until his death, which occurred on Oct. 29, after a brief illness following an operation.

William T. Hogg has been appointed principal assistant engineer.

Bridge River Tunnel Lined at Rate of 50 Ft. Per Day

At Bridge River, site of the 600,000-hp. hydro-electric project now being undertaken by the British Columbia Power Corp., activity is still centered on lining the 2½-mile tunnel which has been bored through Mission Mountain, the watershed between Bridge River and Seton Lake. The work of lining the bore is proceeding at the rate of 50 ft. a day, and all the concrete is being mixed inside the tunnel.

SOCIETY CALENDAR

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention and road show, St. Louis, Mo., Jan. 10-16.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York, Jan. 21-23.

AMERICAN WOOD PRESERVERS' ASSOCIATION, Washington; annual convention, Philadelphia, Pa., Jan. 27-29.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual meeting, San Francisco, Jan. 26-28.

ENGINEERING INSTITUTE OF CANADA; annual meeting, Montreal, Feb. 4-6.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, St. Louis, Mo., Jan. 19-22.

NATIONAL PAVING BRICK ASSOCIATION, Washington; annual meeting, Pittsburgh, Pa., Feb. 4-6.

NATIONAL READY MIXED CONCRETE ASSOCIATION, first annual convention and exhibit, St. Louis, Mo., Jan. 26.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual convention, St. Louis, Mo., Jan. 27-29.

AMERICAN ENGINEERING COUNCIL will meet in Washington Jan. 16 and 17. The personnel of the administrative board for 1931 will be announced at that time.

ENGINEERS CLUB Charlotte, N. C., at its regular meeting elected the following officers: president, E. A. Terrell; vice-president, E. E. Williams; secretary, E. C. McConnell; treasurer, W. E. Vest.

LAND RECLAMATION DIVISION of the American Society of Agricultural Engineers will hold its annual meeting at San Francisco, Calif., on Jan. 6 and 7. Papers on the program include: "Reclamation in the Sacramento and San Joaquin Delta," "Conservation of the Public Domain," "Water and Power from the Boulder Dam," "Relation of Forest Cover to Water Conservation," "Soil Erosion Problems," "Influence of Reclamation on the Development of Farm Machinery" and "The Financing of Reclamation." The secretary is Raymond Olney, St. Joseph, Mich.

NATIONAL DRAINAGE CONSERVATION AND FLOOD CONTROL CONGRESS will hold its annual meeting at Dallas, Tex., Feb. 18-20. The president is W. G. Potter, Chicago.

Personal Notes

J. S. Pole, assistant engineer of track elevation, Chicago & Northwestern Ry., has resigned.

Paul K. Freese, consulting engineer for appraisal, design and inspection, has moved his office from Gary, Ind., to Chicago.

J. E. Root, special engineer of the Cincinnati Union Terminal Co., has been appointed director of public works for Cincinnati, Ohio.

James A. Peabody, signal engineer of the Chicago & Northwestern Ry., has been appointed engineer of maintenance, to succeed Chester T. Dyke, promoted to chief engineer. Robert A. Sheets, assistant signal engineer, succeeds Mr. Peabody as signal engineer.

Wynkoop Kiersted, consulting engineer, Liberty, Mo., who has maintained his office in Kansas City for the past 23 years, has moved his office to Liberty and will continue his practice there.

G. D. Wadsworth has been appointed manager of the Quebec Central R.R., succeeding I. J. Walsh, who is retiring after 50 years of service.

O. W. Merrill, at one time assistant engineer and later chief engineer of division 10 of the Ohio state highway department, has been appointed director of the highway department.

Obituary

Charles Francis Hanington, last of a notable group of engineers who were associated with Sir Sanford Fleming in surveying proposed routes for the transcontinental line of the Canadian Pacific Railway, died in Ottawa on Dec. 21, aged 82 years.

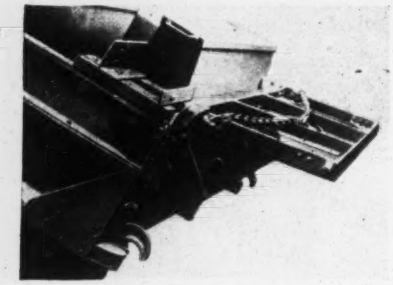
George J. Tompkins, of Nashville, Tenn., city commissioner in charge of sanitation, died of a heart attack on Dec. 24 while preparing to attend a meeting of the board of public works. Mr. Tompkins was 69 years old and had been a resident of Nashville for 37 years. He was first elected a member of the board of public works in 1915.

Hubert Primm Taussig, consulting engineer, of St. Louis, Mo., died on Dec. 21. Mr. Taussig was chief engineer for the Terminal Railroad Association of St. Louis in charge of the engineering work on the St. Louis Union Station in 1893-94. He was an assistant engineer in the construction of the Eads Bridge, and he also supervised the construction of the suspension bridge over the Grand Canyon in Royal Gorge, Colorado. In 1896 he entered the consulting field and also became president of the Western Manufacturers Building Co. He was a member of the American Society of Civil Engineers and of the Engineers Club of St. Louis.

Construction Equipment and Materials

Cement Container Mounted on Batch Truck

Trucks carrying proportioned aggregate from a central plant to the paver or mixer can now be used to carry the proper proportion of cement as well by means of the Cementank, a product of the Blaw-Knox Co., Pittsburgh, Pa. This is a welded steel box, moistureproof, equipped with a hinged top cover and a discharge door which opens automatically when the compartment is dumped. Operation is automatic, requiring absolutely no attention on the part of the driver. The cement empties by gravity and flows with the aggregates into the skip of the mixer. Arching of cement is prevented by the shape of the tank and its method of discharge. The discharge door is flashed with felt to prevent leakage. The cement tank has a capacity of 10.35 cu.ft., sufficient for a seven-bag batch.

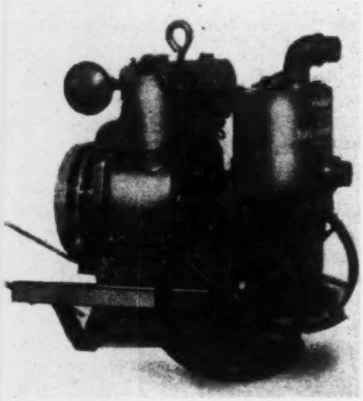


Cement Box on Batch Truck

◆

Compact Self-Priming Pump

Although light enough to be easily handled on the job, the new 2-in. portable self-priming centrifugal pump known as the Humdinger and manufactured by the Ralph B. Carter Co., 192 Atlantic St., Hackensack, N. J., is of sturdy construction to withstand the shocks incident to construction work. Features of the unit include a heavy alloy non-clogging open impeller, oversize turned and ground shaft, deep stuffing box and a four-cycle air-cooled engine equipped with Timken bearings and built especially for centrifugal pump work. The absence of any complicated priming mechanisms or manually controlled levers or valves makes this pump as simple and foolproof as a plain centrifugal pump. The outfit will prime and reprime itself continuously and automatically on all suction lifts up to 28 ft. Its capacity approximates 6,000 gal. per hour under the usual working conditions, although outputs as high as 7,500 gal. per hour have been obtained. Extreme over-all dimensions of the standard outfit are: length, 28 in.; width, 11 in.; height, 25 in.

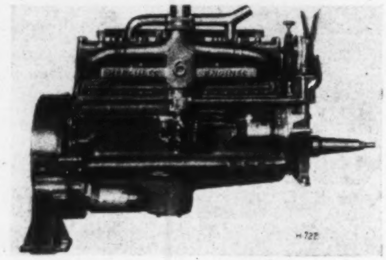


Self-Priming Centrifugal Pump

◆

Series of Six-Cylinder Motors

Five different sizes of six-cylinder "L" head motors ranging in piston displacement from 638 to 935 cu.in. comprise the HX series recently announced by the Hercules Motors Corp., Canton, Ohio. All engines in this series are identical in design and alike as to outside or installation measurements. They differ only in the bore of the cylinders and in such parts as are thereby affected. In the five models the bore increases in $\frac{1}{4}$-in. increments from $4\frac{3}{4}$ in. to $5\frac{3}{4}$ in. Developed horsepowers range from 118 to 175 hp. at 1,600 r.p.m., the three lighter models producing from 136 to 164 hp. at 2,000 r.p.m.



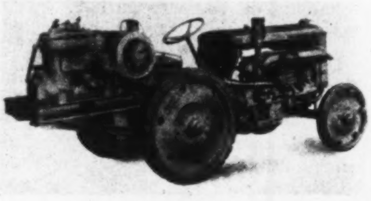
Manifold Side of Motor

Unusual features of the new motors include a connecting rod design in which the bolts which secure the lower bearing cap to the rod are forged integrally with the rod. This design assures extreme strength, since the rod is not weakened by the usual drilling and milling for the bolt and head. It also places the clamping action much closer to the bearing edge than usual. The lubricating system consists of a full-pressure-type, gear-driven oil pump with a double scavenging pump arrangement which assures proper circulation even when the engine is running at an angle. Downdraft manifolds are available as optional equipment, as are exhaust manifolds of the center or rear outlet type. Ignition can be by either battery or magneto. Crankshafts are carried on seven bearings, camshafts on eight. Particular attention has been paid to cooling, a water pump of large capacity being used to assure safe operation at high speed. The fan assembly consists of a six-blade fan driven by double V belts.

◆

Tractor-Mounted Compressor

Introduction of a new tractor-compressor model, consisting of a 110-ft. Metalweld-Worthington air compressor mounted on the Allis-Chalmers Model U industrial tractor has been made by Metalweld, Inc., Philadelphia, Pa. The compressor unit, mounted on the rear of the tractor and connected to the power take-off, consists of a vertical duplex two-cylinder compressor displacing 110 cu.ft. at 900 r.p.m. It has a bore of $5\frac{1}{2}$ in. and stroke of $4\frac{1}{2}$ in., and is equipped with the Worthington valve mechanism. Lubrication is by positive force feed to all main and connecting rod bearings, including wrist pins. Standard equipment includes a pneumatic throttle control which reduces engine speed to idling when the compressor reaches a predetermined maximum pressure, and a bronze flusher-type unloader.

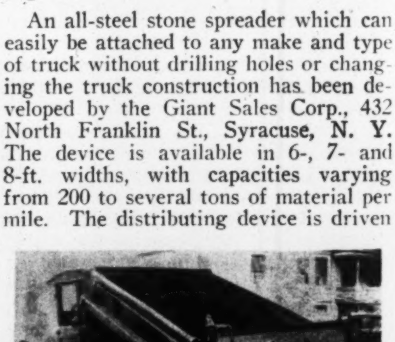


Compressor Unit Mounted on Tractor

◆

Spreader Attachment for Trucks

An all-steel stone spreader which can easily be attached to any make and type of truck without drilling holes or changing the truck construction has been developed by the Giant Sales Corp., 432 North Franklin St., Syracuse, N. Y. The device is available in 6-, 7- and 8-ft. widths, with capacities varying from 200 to several tons of material per mile. The distributing device is driven



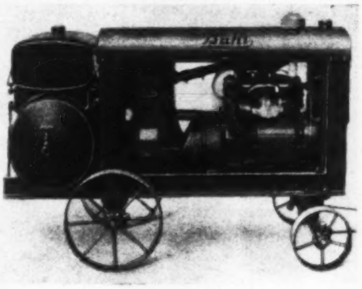
Spreading Device

from the rear wheel of the truck by means of a link chain, as is shown in the illustration. This is provided with a manual control so that the spreader can be engaged or disengaged while the truck is in motion. Besides being useful for spreading stone, the spreader can be used with calcium chloride, sand, cinders or other granular material for the purpose of laying dust or providing a non-skid surface on icy pavement.

◆

Small Air Compressor Unit

Fundamentally designed along the same lines as the larger machines produced by this company, the new type FJ-36 portable air compressor produced by the Buhl Co., 407 South Dearborn St., Chicago, Ill., is intended for heavy-duty continuous service on isolated jobs where a heavy machine is not necessary. The unit has a displacement of 36 cu.ft., capacity to operate a single riveting hammer, pneumatic spade or air grinder, or four spray guns for paint. It is powered by a four-cylinder 10-hp. water-cooled Fuller & Johnson gasoline engine with a rated speed of 1,200 r.p.m. This is direct-connected to a two-cylinder Buhl compressor, 3-in. bore and 3¼-in. stroke, with full force-feed lubrication. Regular equipment includes air gage, safety valve, drain valve, service valve, automatic unloader and oil gage. The unit can be mounted on wheel trucks or on skids.

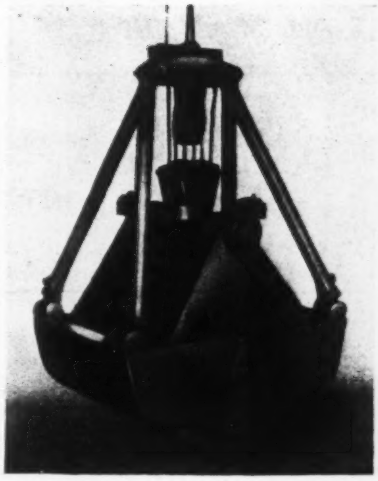


36-Ft. Compressor Unit

◆

Welded Clamshell Bucket

A new development of the Hayward Co., 50 Church St., New York City, is the class "K" digging clamshell bucket illustrated herewith. The bowl of this bucket is of one-piece steel construction, has manganese steel bushings, shoes and teeth, and hardened steel shaft and pins. The rods are of extra heavy pipe; the upper and lower ends are steel castings, and all connections are made by electric welding.

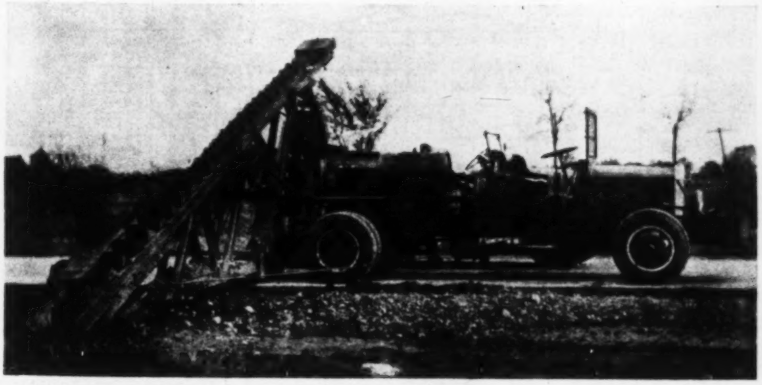


Improved Clamshell Bucket

◆

Road Shoulder and Ditch Formed by Finishing Machine

Road shouldering, the bane of the highway-building contractor, has been mechanized and can now be accomplished to specification by a small crew of men and the Whitcomb-Lehmer shoulder finishing machine, manufactured and sold by the George D. Whitcomb Co., Rochelle, Ill. This new tool forms the shoulder and ditch contours with mechanical precision, shaping, smoothing and carrying off the excess dirt in a single operation. The ingeniousness of the shaping device is in keeping with the unusual transmission, which is of dual type and permits a range of speeds to accommodate the machine to any soil conditions that may be encountered. The device consists of elevating buckets operating on a rigid boom, mounted on a heavy-duty Sterling truck chassis, having an auxiliary transmission especially designed to give the necessary slow speeds and powered with an 80-hp. Waukesha six-cylinder engine. Grade is maintained by a hydraulic hoist controlled by the boom assembly. The buckets travel across the shoulder and ditch contour, conveying the excess soil up and over the machine and loading it into a dump truck which travels along beside it. When not in service the finishing unit can be dismantled, releasing the truck for general work, or it can be trailed from one operation to another at speeds up to 25 m.p.h. The machine can be operated on the highway without interrupting traffic.

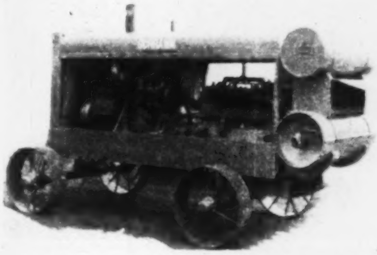


Grading and Shaping Road Shoulder by Machine

◆

Diesel Motor Drives Compressor

Although a radical departure from conventional practice in the use of a diesel engine as a power unit, the new 360-cu.ft. air-compressor unit introduced by Schramm, Inc., Westchester, Pa., follows the usual practice of this company in all other respects. The compressor unit is the standard Schramm four-cylinder, single-stage, vertical water-cooled compressor suitable for 100 lb. per sq.in. maximum working pressure. It is connected to the driving motor by means of a clutch which permits the starting of the engine independent of the compressor. The main driving unit is a Buda type MAN full-diesel motor with a bore of 6 in. and a stroke of 8 in., which operates at 780 r.p.m. It develops 90 hp. A two-cylinder air-cooled auxiliary gasoline engine is built in for starting duty. This starting engine is equipped with a Bendix drive and develops 4 hp. The complete outfit is mounted on an exceptionally large and heavy steel base, and can be obtained mounted on skids, on steel or rubber-tired wheels, or for mounting on a motor truck.



Compressor Driven by Diesel Motor

◆

Side-Boom Unit for Tractor

The side-boom and hoist unit manufactured by the W-K-M Co., Inc., Houston, Tex., is now available for attachment to Allis-Chalmers 35 track-type tractors and industrial wheel-type tractors. Although developed primarily for pipe-line work, the side-boom unit also performs well with dragline or clamshell bucket, drag board or magnet, and can be used in many types of construction. Features of the attachment were fully described in *Engineering News-Record*, Oct. 17, 1929, p. 636.

Business Side of Construction

December Construction 16 Per Cent Above Year Ago

December volume of engineering construction, though the smallest of any month of the year, was 16 per cent above that of December, 1929, when the first severe reaction of the stock market drop was recorded in the construction industry. The month's total was $172,815,000, of which 58 per cent was public, compared with 45 per cent a year ago. All classes of public works are in heavier volume except for an unimportant drop in water-works and the same amount of building as in December, 1929.

Private construction, though below that of a year ago, was only 10 per cent below in the Middle Atlantic states and was above in the South and in the area between the Mississippi and the Rockies. Public-works construction was higher in the eastern half of the country.

All Construction Down 30 Per Cent For the Year 1930

VALUE of all construction in the United States in the last three years totaled: $10,000,000,000 in 1928; $9,130,000,000 in 1929; $6,525,000,000 in 1930. The year 1928 was the record to date. The 9 per cent drop in 1929 was the result of a 31 per cent fall in residential building volume. The 30 per cent drop in 1930 was due to a further fall of 42 per cent in residential building and a fall of 24 per cent in other construction.

The only important component recording an increase was public-works construction. This component in 1928 and 1929 amounted to 36 and 37 per cent respectively, of all construction. Last year however, due to the building decline, public works totaled 53 per cen though the increase over 1929 was onl 3 per cent.

The engineering construction component, including the larger structur of all classes, dropped 20 per cent, du

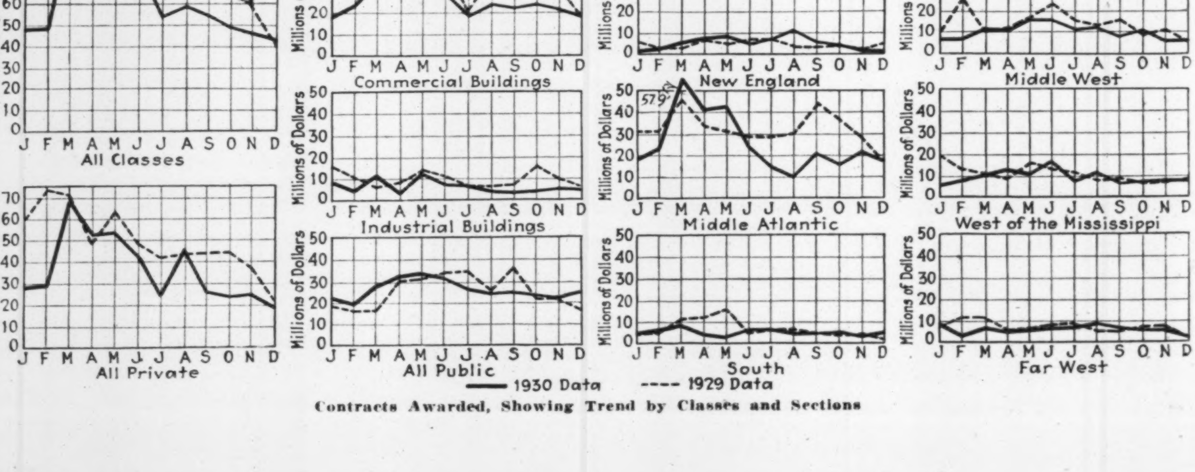
PER CENT CHANGE BY CLASSES AN GEOGRAPHIC SECTIONS

	1930	1929	1930 Per Cent Chg.	Avg. 1925-30	193 Pe Cen Ch
Water-works	49	49	0	63	+2
Sewers	82	88	—7	97	—15
Bridges	109	98	+10	94	+16
Excavation	34	32	+6	34	0
Roads	577	539	+7	527	+9
Buildings	298	306	—3	251	+19
Federal gov't	116	104	+11	71	+64
Unclassified	124	132	+6	124	0
Total public	1,389	1,348	+3	1,261	+10
Industrial bldgs.	331	547	—59	350	—6
Com'l. bldgs	1,034	1,670	—38	1,360	—24
Bridges	20	38	—47	22	—9
Unclassified	399	349	+14	237	+68
Total private	1,784	2,604	—32	1,969	—9
Total eng. construction	3,173	3,950	—20	3,230	—2
New England	265	238	+11	234	—13
Middle Atlantic	1,288	1,681	—23	1,190	+8
South	270	330	—18	287	—6
Middle West	534	747	—38	677	—21
West of Miss'ppi	490	583	—16	505	—3
Far West	326	371	—12	337	—3

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN DECEMBER, 1930

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States			Canada, Dec. 1930
							Dec., 1930	Twelve Months		
								1930	1929	
Water-works	$204	$376	$84	$554	$694	$325	$2,237	$48,558	$48,617	$1,042
Sewers	82	782	254	3,568	680	303	5,669	82,189	87,674	1,935
Bridges, public	202	333	2,660	1,504	913	677	6,289	109,390	97,992	441
Excavation	20	9	1,467	921	1,304	41	3,762	34,376	31,570	323
Streets and roads	1,814	3,437	7,827	1,204	8,534	2,834	25,650	576,993	539,352	1,121
Federal government	41	5,769	3,258	560	2,386	286	12,300	116,445	103,901	....
Unclassified, public	291	18,243	323	3,006	470	582	22,915	123,552	131,685	287
Buildings, public	1,091	6,491	3,294	6,745	1,910	1,263	20,794	297,719	305,702	1,808
Total public	3,745	35,440	19,167	18,062	16,891	6,311	99,616	1,389,222	1,346,493	6,957
Buildings, industrial	834	5,880	620	1,760	1,247	1,405	11,746	331,171	547,313	450
Buildings, commercial	5,350	28,825	1,127	1,200	11,115	4,125	51,742	1,033,672	1,670,285	2,888
Bridges, private	....	....	....	....	100	....	100	20,183	37,596	....
Unclassified, private	255	1,016	1,749	3,080	3,261	250	9,611	399,011	348,628	1,821
Total private	6,439	35,721	3,496	6,040	15,723	5,780	73,199	1,784,037	2,603,822	5,159
December total, 4 weeks	**10,184**	**71,161**	**22,663**	**24,102**	**32,614**	**12,091**	**172,815**	....	....	**12,116**
November, 1930, 4 weeks	12,856	82,950	14,605	25,376	31,059	22,488	189,334	....	....	13,580
December, 1929, 4 weeks	16,953	67,925	6,855	20,589	34,916	13,970	161,208	....	....	....
Twelve months, 1930	265,254	1,288,248	270,217	533,733	490,014	325,793	....	3,173,259	....	187,706
Twelve months, 1929	237,938	1,680,502	329,984	747,032	583,487	371,372	....	....	3,950,315	189,248



Contracts Awarded, Showing Trend by Classes and Sections to the slump in building. This component, which amounted to 36 and 43 per cent of all construction in 1928 and 1929, totaled 49 per cent in 1930. The accompanying tabulation gives values in millions of dollars by classes and geographic sections for 1930 and 1929, and the average for the last six years.

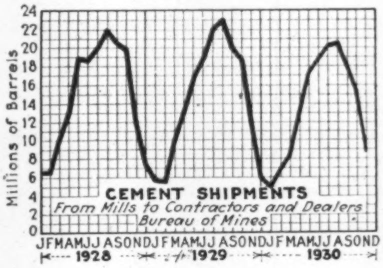
◆

Cement, Brick, Gypsum and Clay Products Up

In the closing weeks of the year prices were marked up in certain of the more important mason's materials in response to enlivened inquiry coming at a time when both distributors' and consumers' stocks were low.

The upturn was in cement, brick, gypsum and clay products, yet the market as a whole had some weak spots, as lower prices for piles, sewer pipe, metal lath and asphalt.

Cement—The reduction of 5c. in dealers' discount has reacted in the form of a rise of 10 to 15c. per barrel, to $2.23 net, delivered at New York. Philadelphia dealers advanced quotations 5c. Contrary to the action of the dealers, six mills lowered prices 8c. per barrel in December. Two of these mills were in Pennsylvania; the others in Indiana, Missouri, New York and Minnesota.

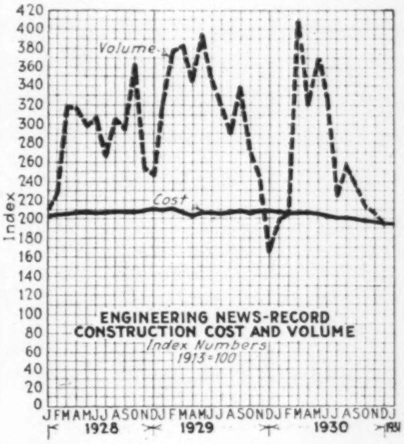


Brick—Wholesalers ask $11 per 1,000 for common grade f.o.b. New York, $1 more than last quarter. Retailers have not gathered sufficient strength to add another dollar to the delivered price, but the rise at dock will check cutting under, which has reached $1 to $1.50 per 1,000 in the last two months. Other clay products except sewer pipe and plaster have been notably firmer in the last month.

Sewer Pipe—A small decrease in prices of pipe under 30 in. went into effect at Pennsylvania plants in December.

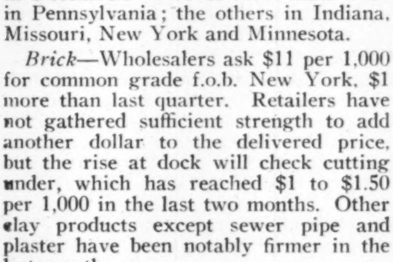
Construction Cost and Volume Index Numbers

Costs dropped 1.2 per cent in December and are now 6 per cent below those of April, when the decline started; 7 per cent below a year ago. Volume index is 7 per cent below that for November and 16 per cent more than that of December, 1929.



E. N.-R. Cost		E. N.-R. Volume*	
Jan., 1931	**194.48**	**Dec., 1930**	**192**
Dec., 1930	196.86	Nov., 1930	207
Jan., 1930	208.96	Dec., 1929	166
1930 (average)	202.85	1930 (average)	260
1929 (average)	207.02	1929 (average)	317
1913 (average)	100.00		
1929		1929	
January	209.40	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290
September	207.57	September	340
October	206.32	October	273
November	208.46	November	245
December	209.46	December	166
1930		1930	
January	208.96	January	199
February	206.46	February	204
March	206.80	March	408
April	207.12	April	320
May	205.86	May	354
June	203.36	June	324
July	200.95	July	226
August	200.95	August	259
September	199.58	September	232
October	198.72	October	211
November	198.54	Nove,ber	207
December	196.86	December	192

*Corrected for price change since 1913.



Asphalt—Package asphalt is off $1 per ton, to $17 at Philadelphia and $21.40 in Seattle.

Wood Blocks—St. Louis market dropped 30c. per square yard to $2.10 last month; Chicago prices declined in the preceding month. Price changes in blocks are extremely infrequent.

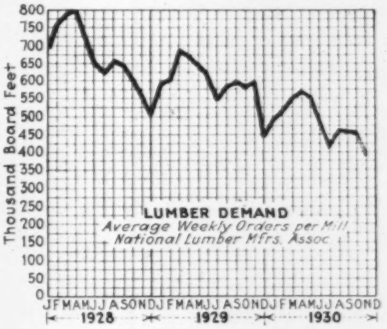
Metal lath has been subjected to price slashing for many months. In December, New York and St. Louis quotations sagged. Dealers cut prices regardless of steady steel-sheet quotations.

Ship Spikes—San Francisco quotations are off 5c. per 100 lb., to $5.50 on ½-in. spikes. Other sizes changed accordingly. Barge building is now active with steel favored.

Pine piles f.o.b. barge, New York, down 1 to 2c. per linear foot in lengths up to 89 ft.

Railway Ties—Fewer ties are being used. The annual rate of consumption is now around 86 millions, compared with 103 millions in 1927. The San Francisco market on treated fir ties, 6x8 in., dropped 1c. to $1.41. The St. Louis market, on the other hand, rose 5c. to $1.35, for red oak treated.

Lumber—An appreciable quantity of lumber is being taken by railroads in their maintenance-of-way and car-building programs. Ocean freight rate for January is up 50c. per 1,000 ft., to $10.50. Thus far there has been no compensating advance in dealers' delivered prices. Lumber cutters were more successful in 1930 than in 1929 in adjusting their production to demand. In 1930 the mills took orders for 12 billion feet and produced that amount. In 1929 orders totaled 15 billion feet, while production exceeded that by a billion feet. Demand has been too light to prevent prices from slipping, regardless of close supervision of production. New York delivered price, for example, on pine 3x12's is $73, against $75 on Jan. 1, 1930. Western mills are keeping production slightly under orders, while in the northern pine region cutting stopped at the end of the year. Hardwood and Southern pine producers have not held down production in the last eight weeks. Dealer buying, to a great extent, is restricted to the point where yard men are crosscutting long stock and ripping up large timbers instead of buying new small-sized material. Wholesale prices are firm. Retailers, nevertheless, cut prices of pine 3x12's $1, to $59, at St. Louis and $2, to 58, at Philadelphia during December. Fir 3x12's are off $3, to $57, at Pittsburgh.



Limestone — The Indiana producers have sufficient business booked to keep cutting forces busy until the arrival of the spring quarrying season. The large orders are for railroad, governmental and educational buildings. Prices are steady, with run of quarry $1.27 per cubic foot f.o.b. New York, or 10c. under the last change, which occurred in September, 1930.

Steel—The current price for shapes

at Pittsburgh mill is $1.60 to $1.65 per 100 lb. The December price was $1.60 flat. The range is explained in this way, that the large-tonnage users are covering at $1.60, while the higher figure is quoted to average buyers. The Jan. 1, 1930, quotation stood at $1.90, mill.

A wide variety of minor materials are notably steady as to price, as the trade moves over into a new year. These are concrete blocks, slate, paving stone, crushed stone, flagging, curbing, road oils, steel in small forms, roofing, sheathing, glass, lime and explosives.

Below is a comparison of current f.o.b. prices on 27 important materials with levels of Jan. 1, 1930, showing twelve unchanged, twelve lower and three higher.

	Jan. 1, 1931	Jan. 1, 1930
Cement, Chicago, net	$1.95	$1.85
Sand, N. Y., del., yd	2.15	2.15
Gravel, N. Y., del., yd	3.40	3.40
Wire rein., .032, Pitts., C sq.ft.	.99	.99
Granite blocks, N. Y., M	150.00	150.00
Wood blocks, 3½, Chi., sq.yd.	2.00	2.10
Curbing, 5 in., St. L., ft	1.00	1.00
Asphalt, Maurer, ton	30.00	30.00
Road oil, Dallas, gal	.06	.0512½
Tile, 10-in., Perth Amboy	.2388	.2388
Brick, N. Y., del., M	13.00	14.00
Lime, c.-l., del., Boston, bbl.	3.10	3.00
Steel shapes, Pitts., 100 lb.	1.60 (min.)	1.90
Bars, rein., Pitts., 100 lb	1.70	2.00
E.l met. lath, 2 2s. del., Chi., C sq.yd	10.10	20.50
Rivets, Pitts, 100 lb	2.75	3.10
Sheetpiling, Pitts., 100 lb	2.25	2.25
Wire nails, Pitts., 100 lb	1.95	2.40
Rails, std., Pitts., ton	43.00	43.00
Ties, w.-oak, 6 in., Chi	1.35	1.40
Spikes, std., Pitts., 100 lb	2.80	2.80
C.-i. pipe, 6-in., Birm	37.00	37.00
Sewer pipe, 6-in., del., Pitts., ft.	.09	.0945
Linseed oil, Minn., lb	.101	.164
Red lead, N. Y., 100 lb	13.75	13.75
Pine, 3x12, del., N. Y., M. ft	73.00	75.00
Fir., 3x12, del., Seattle, M. ft	20.00	21.00

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Employment Outlook

Employment conditions in the construction industry are given below:

Boston — Of 21,000 building mechanics, 10,000 are now without work. Present wage contracts expire in April, 1931, at which time efforts may be put forth to abrogate the agreement in favor of lower rates. In the Brookline district but 200 persons are reported as unemployed, carpenters having fared particularly well in this area.

New Haven—City street improvement work taking 150 men from idle list.

Rochester—It is proposed that unskilled men be employed at 60c. per hour three days a week instead of the usual rate of 45c. for four days.

Schenectady—General Electric Co. announces that 50 weeks' employment will be guaranteed incandescent lamp workers in 1931.

New York—Erectors of wooden concrete forms on city contracts were officially recognized as carpenters instead of laborers by the comptroller, thus terminating a dispute of long standing. These men are now entitled to $13.20 per day.

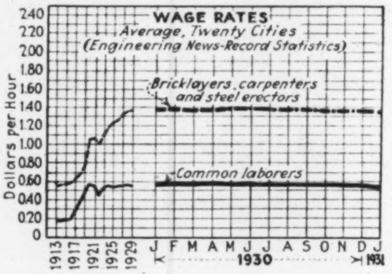
Newark—About 3,000 men granted employment at $4 per day for the remainder of the winter on pick and shovel work for the Newark City Railway. Carpenters and contractors of Essex County were to adopt "stagger system."

Jersey City—Hudson County allows $600,000 for highway repairs to relieve unemployment.

Pittsburgh—Resumption of operations at the Creighton plant of the Pittsburgh Plate Glass Co. employed 500 men in the grinding and polishing departments.

Philadelphia — Stone masons retract demand for $1.50 per hour. Unemployment increasing.

Baltimore—Sparrows Point tin mills of Bethlehem Steel Corp. re-employed 200 men Dec. 17.



Washington—The Presidents' emergency committee on unemployment reported Dec. 12 number of men on public works, as follows:

	1930	1929	Per Cent Over 1929
Cities (210)	249,000	225,000	10.6
States (20)	182,000	172,000	5.8
Federal-aid roads	289,000	259,000	11.5

Youngstown—Pipe mills of Republic Steel Corp. now operating 24 hours on orders for delivery in first half of 1931.

Chicago—Building Construction Employers Association estimates 60 per cent of craftsmen are without work in Chicago. Attempt has been made to reduce overtime costs and to induce mechanics to relinquish the five-day week.

Detroit — Hudson-Essex factory employment total at 9,244 on Dec. 16, against 3,500 in November. Former employees only are given work. City construction is being performed by men placed through the public welfare department.

Knoxville—Paving and grading appropriations for 1931 provide a speci relief fund of $150,000 for hiring unemployed men at hand labor on street wor until such fund is exhausted.

St. Louis—Building mechanics largel on part time. Sharp curtailment o forces in following industries: lea mines; cigar; shoe; soap; railroads steel and woodworking mills; aut assembly; building materials plants.

Birmingham—Bond issue of $1,000,000 proposed for beautifying publi parks and painting public buildings.

Austin—At least 1,000 men will b given work in the first half of 1931 o 272 miles of state highways.

San Francisco—More than 1,000 me given work on city projects in December, replacing a group of 1,075 put t work in November.

Sacramento—Southern Pacific shopmen return to full time Jan. 5, after three-day shifts for the last two months.

Montreal—Unemployed asked to register, but lists are light in view of the reported distress.

Wage Rates—The skilled labor rate is $1.37½ per hour, compared with $1.38 in December and $1.37 Jan. 1, 1930. In manufacturing the average skilled rate is 66.4c. per hour. The common labor rate is 53.84c. per hour, compared with 55.03c. in December and 56.28c. Jan. 1, 1930. In manufacturing the unskilled rate is 49c.

The *E.N.-R.* yearly average rates since 1913 are given below:

	Skilled	Common		Skilled	Common
1913	$0.55½	$0.19	1923	1.10	.518
1914	.56½	.177	1924	1.19	.555
1915	.57	.182	1925	1.22	.538
1916	.58	.192	1926	1.26	.548
1917	.61	.281	1927	1.32	.554
1918	.68	.38	1928	1.35	.5558
1919	.78	.466	1929	1.36	.5465
1920	1.05	.579	1930	1.38	.5607
1921	1.06	.54	Jan. 1,		
1922	1.00	.442	1931	1.37½	.5384

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Advances since last month are indicated by **heavy type**, declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50	....	$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.30
Birmingham	1.50	1.00	1.25	.50	....	1.25	.20@.35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	*.35*@.60
Chicago	1.70	1.62½	1.62½	.97½	1.62½	1.62½	.97½
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.35@.60
Dallas	1.75	1.12½	1.25	*.35*@.75	1.25	*1.25*	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	....	1.25	*.20*@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	1.31¼	1.31¼	.90	1.31¼	1.31¼	.35@.50
Los Angeles	1.37½	1.00	1.00	.75	.87½	1.00	.50
Minneapolis	1.30	.90	.90@1.00	.80	....	1.00@1.25	.50@.65
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.92½	1.65	1.92½	1.03½	1.10@1.23¾	1.92½	1.03½
Philadelphia	1.75	*1.25*	1.02½@1.36	.70@1.12½	1.00	1.37½@1.62½	.40@.50
Pittsburgh	1.75	1.50	1.50@1.56½	1.12½	....	1.50	.40@.80
St. Louis	1.75	1.50	1.60@1.75	1.15@1.25	1.25	*1.50*	.40@.87½
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.68¾
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70
Average	1.58	*1.21*	1.28	*0.8715*	1.14	*1.33*	*0.538¼*
Montreal	1.25	.80	.75	....	.90	1.00	.30@.35

*Minimum rates are non-union and for construction other than buildings.

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per barrel, for cement in cloth, *without charge for bags,* cash discount not deducted. Prices are delivered by truck to contractors, except those marked F.O.B., which are manufacturers'. For cement in paper bags add 15c. per bbl:

	Jan. 1, 1931	One Mo. Ago	One Yr. Ago
Atlanta	$3.00	$3.00	$2.35
Baltimore	2.60	2.60	2.40
Birmingham	2.60	2.60	2.40
Boston	2.35	2.35	2.28
Dallas	2.15	2.15	2.15
Denver	2.61	2.61	2.61
Jersey City	2.33	2.33	....
Kansas City	2.07	2.07	2.65
Los Angeles	1.92	1.92	2.42
Montreal	2.20	2.20	2.05
New Orleans	2.35	2.35	2.65
New York	**2.23**	2.10	2.30
Philadelphia	**2.15**	2.10	2.10
St. Louis	2.15	2.15	2.10
San Francisco	2.64	2.64	2.54
Seattle	2.25	2.25	2.70
(F.O.B.)			
Cedar Rapids		2.23	2.04
Chicago	*New prices will be announced soon*	1.95	1.85
Cincinnati		2.14	1.92
Cleveland		2.04	1.94
Davenport		2.14	2.04
Detroit		1.95	1.95
Duluth		2.04	1.94
Indianapolis		1.99	1.89
Milwaukee		2.10	2.00
Minneapolis		2.27	2.02
Peoria		2.12	2.02
Pittsburgh		1.95	1.85
St. Paul		2.27	2.02
Toledo		2.10	2.03

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich	$1.65	Mason City, Ia	$1.85
Buffington, Ind	*1.62*	Norfolk, Va	1.87
Hannibal, Mo	*1.72*	Northampton, Pa	*1.67*
Houston, Tex	1.95	North Birmingham, Ala	1.67
Hudson, N. Y	*1.77*	Richard City, Tenn	2.05
Ironton, Ohio	1.67	Steelton, Minn	*1.77*
Iola, Kan	1.85	Universal, Pa	*1.62*
La Salle, Ill	1.80	Wyandotte, Mich	1.70
Limedale, Ind	1.70		

SAND AND GRAVEL—Per ton, delivered by dealers. Weight of sand per cu.yd., 1½ tons; gravel, 1½ tons, unless otherwise specified in pounds:

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta	$3.25	$3.25	$2.50
Baltmore	2.35	2.55	2.08
Birmingham, per cu.yd., 2,600 lb	3.50	3.50	3.00
Boston	1.75	1.75	1.15
Chicago, per cu.yd	2.00	2.00	2.00
Cincinnati	1.75	1.75	1.50
Cleveland, per cu.yd., 3,000 lb	2.60	2.60	2.50
Dallas, per cu.yd., 2,750 lb	3.00	3.00	2.50
Denver, per cu.yd., 2,700 lb	1.95	1.95	1.35
Detroit	2.50	1.85	1.65
Kansas City	1.75	1.75	1.75
Los Angeles	1.50	1.50	1.00
Minneapolis, per cu.yd., 2,800 lb	2.40	2.40	1.10
Montreal	1.25	1.25	1.25
New Orleans, per cu.yd., 2,700 lb	2.95	2.95	1.80
New York, per cu.yd	3.40	3.40	2.15
Philadelphia	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh	1.55	1.55	1.75
St. Louis	*1.40*	1.40	1.00@1.20
San Francisco	1.75	1.75	1.75
Seattle, per cu.yd., 3,200 lb	1.75	1.75	*1.65*

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb. per cu.yd.

CRUSHED STONE—Per ton, delivered by dealers. Weight per cu.yd., 1½ tons, unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta	$3.25	$3.25
Baltimore	2.60	2.80
Birmingham, limestone, per cu.yd	3.00	3.25
Boston	2.00	2.00
Chicago, limestone, per cu.yd., 2,500 lb	2.00	2.00
Cincinnati	2.25	2.25
Cleveland	2.60	2.60
Dallas, per cu.yd., 2,500 lb	3.25	3.25
Denver, granite, per cu.yd., 2,700 lb	2.50	2.50
Detroit, limestone	2.25	2.25
Kansas City	1.90	1.90
Los Angeles	1.40	1.40
Minneapolis, limestone, per cu.yd., 2,600 lb	2.40	2.40
Montreal	1.90	2.10
New York, limestone, per cu.yd	3.40	3.40
Philadelphia, limestone	2.30@3.15	2.30@3.15
Pittsburgh	2.75	2.75
St. Louis	1.40@1.60	1.40@1.60
San Francisco, trap rock	1.65	1.65
Seattle, per cu.yd., 2,700 lb	3.00	3.00

CRUSHED SLAG—Manufacturers' quotation on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.10	1.10	....	1.30
Western Pennsylvania	1.25	1.25	2.00	1.25
Toledo, Ohio	*1.10*	*1.10*	*1.10*	*1.00*
Youngstown District	1.25	1.35	2.00	1.25

HOLLOW TILE—Building tile per block, delivered by dealers to contractor in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.14	$0.18	$0.24	$0.30	$0.36
Baltimore	.105	....	.20	....	.26
Birmingham	.09	.127	.174	.218	.261
Boston	.08	.113	.15	.21	.25
Chicago	.064	.088	.12	.1548	.172
Cincinnati	.06815	.09485	.129	.165	.184
Cleveland	.064	.088	.128	.171	.19
Dallas	.103	.136	.194	.251	.306
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	.184	.24	.265
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0611	.081	.10605	.1302	.1737
New Orleans	.068	.093	.13	.176	.212
New York	.0864	.1296	.162	....	....
Perth Amboy, N. J. (f.o.b.)	.....	....	....	.2388	.2956
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.056	.078	.1175	.14	.1726
St. Louis	*.075*	*.10*	*.15*	*.175*	*.21*
San Francisco	.108	.156	.255	....	....
Seattle	.085	.115	.18	....	....

BRICK—Prices delivered by dealers per thousand, are as follows:

		Paving F.O.B.	
	Common	3x8½x4-In.	3½x8½x4-In.
Atlanta	$16.25	$42.00	.....
Baltimore	13.00	40.00	$46.00
Birmingham	**15.50**	31.00	.....
Boston	15.00	43.00	47.00
Chicago	12.00	42.00	45.00
Cincinnati	16.00	35.00	37.00
Cleveland	12@14	33.00	36.00
Dallas	14.50	29.50*	.....
Denver	11.00	.....	.....
Detroit	15.50	33.50	36.50
Kansas City	14.50	.....	.....
Los Angeles	**10.00**	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.00	.....	.....
New Orleans	12.00	38.00*	45.00
New York (See note)	13.00	45.00	50.00
Philadelphia	*15.50*	40.00	*45.00*
Pittsburgh	16.00	40.50	45.00
St. Louis	12.00	38.00	38.00
San Francisco	12.00	45.00*	.....
Seattle	14.00	46.50†	61.00‡

*2½x8½x4 in. †2¼x8½x4. ‡3¼x8½x4. Note—**Face brick,** rough red, del., New York, $30.00 per M.

LIME—Prices delivered by dealers to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$23.00	$15.50	......	......
Baltimore	22.00	14.00	$2.55†	......
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	22.00	14.00	4.00*	3.10*
Chicago	17.00	14.50	15.00‡	15.00‡
Cincinnati	13.05	10.70	......	......
Cleveland	14.00	**12.00**	2.50†	2.50†
Dallas	20.00	......	2.35†	1.80†
Denver	32.00	**23.75**	3.80*	3.00*
Detroit	18.00	**14.80**	2.20†	2.00†
Kansas City	22.00	12.50	3.00†	2.50†
Los Angeles	18.90	16.00	2.85†	14.00‡
Minneapolis	25.50	**21.00**	......	1.70†
Montreal	19.75	......	......	15.00‡
New Orleans	25.00	15.50	2.65†	1.95†
New York	21.00	13.00	4.10*	3.15*
Philadelphia	22.00	15.00	......	......
Pittsburgh	20.00	15.00	4.25*	......
St. Louis	24.00	18.00	15.00‡	2.75†
San Francisco	20.00	20.00	......	1.85†
Seattle, paper sacks	35.00	24.00	......	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

LIMESTONE—Blocks, f.o.b. siding, N. Y., per cu.ft., standard, $1.57; run of quarry, $1.27.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.18@$0.20	Minneapolis	$0.11
Brooklyn and Queens	.12@ .14	New Orleans	.20
Cleveland	.16@ .17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.17
Kansas City	.18		

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$9.00@$14.00
No. 1 Ribbon	7.50@ 10.25
Medium Clear	8.00@ 10.50

Road and Paving Materials

PAVING STONE—Carload lots of granite blocks, 4x8x4-in., dressed, f.o.b.:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M.
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½x8x5 in.	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.25
Chicago	3½	12	2.00
Cincinnati	3½	16	2.35
Kansas City	3½	16	2.75
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.40
New York	3½	16	2.50
St. Louis	3½	16	*2.10*

FLAGGING—Alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16-in., f.o.b., $1.00 per lin.ft.; roundings, $1.35 per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls or 425-lb. drums); also in tank-car lots, f.o.b. points listed:

	Package	Tank-car
Atlanta (Mexican)	$20.40	$17.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	23.00	18.00
Chicago (Texas)	23.50	19.30
Cincinnati (Kentucky Rock)	......	12.30
Cleveland	24.00	20.00
Dallas (Texas)	24.40	20.00
Denver (California)	35.00	......
Detroit (Mexican) (Texas)	19.72	14.87
Kansas City, Mo. (Texas)	30.00	25.00
Los Angeles ("D" Grade, Calif., f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	......
Maurer, N. J. (Trinidad)	25.00	......
Minneapolis, (Stanolind, f.o.b., Twin Cities)	23.10	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	*17.00*	*13.00*
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Mexican)	22.50	18.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle (Standard Oil)	*21.40*	18.00

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	.06
Dallas, 50@60% asphalt	.06
New York, 40@50% asphalt, (at terminal)	.05
New York, 50@60% asphalt, (at terminal)	.05
St. Louis, 40@50% asphalt	.04
St. Louis, 50@60% asphalt	.04

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	$14.00
Pittsburgh, basic, incl. freight ($1.76) from Valley	*19.26*

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.

	Shapes, 3 to 15-In.	Plates, ¼-In.
Birmingham, large mill lots, f.o.b	$2.15	$2.15
Chicago, warehouse, delivered	3.00	3.00
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	3.90	4.00
New York, warehouse, delivered, 400 to 3,999 lb.	3.10	3.10
Pittsburgh, large mill lots, f.o.b	1.60@**1.65**	1.60@**1.65**
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.40	3.40

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ¾-in.:

Birmingham, large mill lots, f.o.b	$2.15
Chicago warehouse, delivered	2.15@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	2.50
New York, warehouse, delivered, over 5 tons	2.70
Pittsburgh, large mill lots, stock lengths, f.o.b	1.70
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.50

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job, in lots under 200 sq.yds:

Lb. per Sq.Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San-Francisco
2.2	*$15.50*	$22.00	$10.10*	$18.00@*19.00*	$18.00	$21.50
2.5	*16.50*	23.00	10.90*	19.00@*20.00*	19.50	22.50
3.0	*18.00*	25.00	12.25*	20.50@*21.50*	.....	25.00
3.4	*19.00*	26.50	13.10*	21.50@*22.50*	24.00	27.00

*More than 200 sq.yds.

WIRE REINFORCEMENT FOR CONCRETE—Plain, 4 in. x 4 in. mesh; manufacturers' quotations per 100 sq.ft. in carloads at mills; dealers' delivered in lots of 10,000 sq.ft. or over:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Del. From Warehouse New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.30	$1.63	$1.22*
049	28	1.26	1.29	1.76	1.70	2.00	1.55*
068	35	1.54	1.58	2.18	2.10	2.25	1.91*
093	45	1.98	2.03	2.79	2.65	2.86	2.46*
126	57	2.45	2.51	3.45	3.30	3.52	3.03*
153	68	2.92	2.99	4.13	4.00	4.20	.....
180	78	3.35	3.43	4.73	4.60	4.80	.....

* F.o.b.

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb. base:

	Blue Annealed No. 10*	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35†	$3.80†	$4.35†
Cleveland, warehouse, delivered	3.00	3.60	4.20
New York, warehouse, delivered	3.40†	3.90	4.25
Pittsburgh, large mill lots, f.o.b	1.90	2.35@2.45	2.90@3.00
St. Louis, warehouse, delivered	3.45	4.05	4.60
San Francisco, warehouse, delivered	3.80	4.35	4.85

*Light plates. †400 lb. to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River.

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
"Special Steel" and extra strong cast steel, round strand rope	27½%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round head, ¾-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4.00
Dallas, warehouse, delivered	5.80
Denver	4.80
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b	2.75
St. Louis, warehouse, delivered	4.15
San Francisco, warehouse, delivered	5.50
Seattle, warehouse, delivered	**5.50**

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$10.30

SHIP SPIKES—Per 100 lb., black, from dealers warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	*$5.50*	*$5.05*	*$4.90*
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Per 100 lb. keg, base, delivered from warehouse stocks; also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$1.95@$2.00	$3.30	$3.30	*$2.40*	$3.50	$3.25	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	*$7.50*	$9.75@$10.25	......
Stove plate	*4.75@5.25*	8.50@ 9.00	**$7.00***
No. 1 machinery cast	8.00	11.25@ 11.75	9.00*
Machine shop turnings	*3.00*	**5.50@ 6.00**	**4.50**
Cast borings	*3.50*	**5.50@ 6.00**	*5.75*
Railroad malleable	*7.50*	13.00@ 13.50	*9.00*
Re-rolling rails	**9.50**	13.00@ 13.50	10.00
Re-laying rails, 56@60 lb.	23.00	23.00@ 25.00	.....
Heavy melting steel, No. 1	7.50	10.00@ 10.50	*10.00*
Iron and steel pipe	7.25	6.00@ 6.50	.....

*Net ton.

FREIGHT RATES—The following freight rates per 100 lb., effective May 20, 1930, apply on finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.:

Atlanta	$0.58*	Detroit	$0.265†
Baltimore	.27†	Kansas City	.695†
Birmingham	.58*	New Orleans	.67*
Boston	.40†	New York	.33†
Buffalo	.235†	Pacific Coast (all rail)	1.15‡
Chicago	.34†	Philadelphia	.29†
Cincinnati	.265†	St. Louis	.39†
Cleveland	.185†	St. Paul	.60*
Denver	1.15‡		

*36,000 lb. †40,000 lb. ‡60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittts-burgh	Birmingham	Chicago
Standard openhearth rails, 110 lb	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb	34.00	34@36	34@36
Re-rolled rails	24@28	34@36	34@36

RAILWAY TIES—For fair-sized orders, f.o.b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.05	$1.20
	Creosoted—prices on application.		
Birmingham	White oak, creosoted	1.52	1.75
	Southern pine, creosoted	1.25	1.60
Chicago	White oak, untreated	1.35	1.70
	Oak, empty cell, creosoted	1.75	2.30
	Oak, zinc treated	1.55	2.05
	Southern pine, creosoted	1.45	1.90
St. Louis	White oak, untreated	1.00	**1.60**
	Red oak, creosoted	**1.35**	**2.00**
	Sap pine or cypress, untreated	**.75**	**1.30**
San Francisco	Douglas fir, green, untreated	.66	*.92*
	Douglas fir, empty cell, creosoted	*1.41*	*2.15*
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb. f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, $\frac{9}{16}$-in. and larger	$2.80	$3.55	$3.45	$3.65@$3.95	$4.10
Track bolts	3.80	4.55	5.85	*4.50*@ 5.00	5.10
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.75	....	.....

Tie plates: Price at Pittsburgh mill, $2.07½ per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	57.3%	44.8%	53.9%	41.4%
Cleveland, warehouse, delivered	53.3%	42.3%	50.8%	37.8%
New York, warehouse, delivered	56.14%	43.6%	52.72%	40.18%
Pittsburgh, large mill lots, f.o.b.	64%	52.5%	61%	49.5%
St. Louis, warehouse, delivered	51%	38%	48%	35%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$40.00@$41.00	$37.00@$38.00
Burlington (N. J.) mill	40.00	37.00
Chicago	48.20@ 49.20	45.20@ 46.20
New York	42.90	39.90
Pittsburgh	48.80@ 49.80	45.80@ 46.80
St. Louis	47.80	44.80
San Francisco	50.00@ 51.00	47.00@ 48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In
Atlanta	$0.15	$0.25	$0.82½	.....	.....	.....	.....
Baltimore	.10	.30	.58	.....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.85
Boston	.18	.28	.55	1.35	2.30	3.90	6.50
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.135	.21	.405	1.12½	2.025	3.672	5.74
Cleveland	.189	.294	.567	1.35	2.43	4.824	7.38
Dallas	.23	.325	.586	1.06	1.95	3.68	5.00
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	.....
Kansas City	.15	.29	.52	1.22	1.90	3.60	.....
Los Angeles	.21	.29	.52	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.85	3.49	4.97
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.18	.30	.54	1.02	1.95	.....	.....
New York	.17	.265	.52	1.30	2.34	4.47	6.86
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	*.09*	*.14*	**.27**	*.75*	*1.35*	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.1925	.275	.495	1.155	1.98	3.30	4.95
Seattle	.22	.30	.54	1.26	2.16	3.50	5.50

CLAY DRAIN TILE—Prices delivered by dealers, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	$60.00
6	112.00	112.00	85.00	100.00	112.50	112.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:
New York.... *$0.092* Chicago.... *$0.098* Minneapolis...*$0.101*

WHITE AND RED LEAD—Base price per 100-lb. keg, f.o.b., New York: White, dry, $13.75; White, in oil, $13.75; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, in bags, per 100 lb	$1.40@$1.45
Sulphate of copper, in bbl., per 100 lb.	**4.25**@ **4.50**
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, cylinders, per lb	04@ .06
Bleaching powder, in drums, f.o.b. works, per 100 lb.	2.00@ 2.10
Calcium chloride, flaked, in drums, f.o.b. works, per ton	22.75

MANILA ROPE—The number of feet per pound for the various sizes is as follows: 5-in., 7-ft., 6-in.; ¾-in., 6-ft., 1-in.; ⅞-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft., 8-in. Following prices are quoted by dealers per pound for ¾-in. and larger:

Atlanta	$0.35	Kansas City	$0.25
Baltimore	.225	Los Angeles	.25
Birmingham	.26	Minneapolis	.19
Boston	.21	Montreal	.185
Chicago	.17	New Orleans	.25
Cincinnati	.21	New York	.205
Cleveland	.21	Philadelphia	*.21*
Dallas	.26	San Francisco	*.17*
Denver	.22	Seattle	.195
Detroit	.225	St. Louis	.205

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point........ *$2.16*

SLATERS FELT—In carloads, per roll, f.o.b., producing point........ *$0.79*

ROOFING MATERIALS—Price f.o.b., New York, delivered by dealers to contractors in carloads:

Asphalt felt, per 100 lb.	$3.00
Tar felt, per 100 lb	3.00
Asphalt coating, per gal.	.34½
Tar pitch, in 350 lb. barrels, per ton	**28.00**

PREPARED ROOFINGS—Prices delivered by dealers to contractors, in carloads, f.o.b. New York, per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	6.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:
AA........... 83% A........... *89%* B........... *91%*

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin			Gelatin	
	40%	60%		40%	60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.20	.225
Birmingham	.22	.245	Montreal	.20	.24
Boston	.225	.255	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.2125	.2475	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.155	.18
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, No. 1 Common, rough, delivered in Manhattan to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Long-leaf Yellow Pine	Douglas Fir
3x4 to 8x8	$52.50	$35.00
3x10 to 10x10	65.00	36.00
3x12 to 12x12	73.00	37.00
3x14 to 14x14	85.00	42.50

Chicago—Prices, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft., b.m.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$41.50	$39.50
3x10 to 10x10	49.00	39.50
3x12 to 12x12	61.00	39.50
3x14 to 14x14	73.00	40.50

San Francisco—Douglas fir, No. 1 common, rough, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft., b.m.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$30.00	$32.00
3x6 and 8	30.00	32.00
3x10 and 12	30.00	32.00
3x14	33.00	34.00

Other Cities—Delivered by dealers, No. 1 Common, rough, per M. ft., b.m.:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine	Fir	Hemlock	Spruce	Pine	Fir
Atlanta	$55.00	......	......	......	$65.00	......
Baltimore	36.00	$50.00	*$53.50*	$61.75	75.00	$50.25
Birmingham	53.00	......	......	......	56.50	......
Boston	52.00	45.00	47.50	48.00	58.00	42.00
Cincinnati	42.50	55.00	......	......	52.50	52.50
Cleveland	54.00	58.00	......	......	58.00	62.00
Dallas	55.00	57.50	55.00	55.00	55.00	50.00
Denver	......	50.00	47.50	47.50	......	55.00
Detroit	53.00	51.00	......	......	67.00	51.00
Kansas City	36.00	34.00	......	......	50.00	34.00
Los Angeles	......	43.50	......	......	......	45.50
Minneapolis	......	46.25	......	......	......	46.25@47.75
Montreal	50.00	48.00	......	......	56.00	48.00
New Orleans	44.00	40.00	......	45.00	65.00	60.00
Philadelphia	50.00	*42.00*	*41.00*	*46.00*	*58.00*	43.00
Pittsburgh	55.00	*62.00*	65.00	**67.00**	75.00	*57@62*
St. Louis	**53.00**	40.00	**40.00**	......	*59.00*	41.00
Seattle	......	**21.00**	......	......	......	20.00

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine	Fir	Hemlock	Pine	Fir
Atlanta	$55.00	......	......	$40.00	......
Baltimore	55.00	$44.50	$44.00	......	......
Birmingham	36.00	......	......	45.00	......
Boston	47.00	40.00	42.50	48.00	$44.00
Cincinnati	45.00	47.50	......	35.00	45.00
Cleveland	65.00	65.00	......	42.00	54.00
Dallas	60.00	......	......	55.00	......
Denver	......	38.00	38.50	......	44.00
Detroit	*47.00*	44.00	......	*47.50*	*45.50*
Kansas City	46.00	33.25	......	40.25	36.25
Los Angeles	......	40.50	......	......	48.50
Minneapolis	65.00*	40.00	......	45.00*	39.00
Montreal	56.00	......	......	......	......
New Orleans	54.00	48.00	......	40.00	40.00
Philadelphia	52.00	*42.00*	*40.00*	*53.00*	*42.00*
Pittsburgh	75.00	**65.00**	55.00	65.00	*55.00*
St. Louis	*43.50*	42.00	**42.00**	**46.00**	43.00
Seattle	......	18.00	......	......	*18.00*

*Northern P.ne, No. 2 Com.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1¾ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	*$0.13½*	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	*.18*	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	*.20½*	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	*.24*	.36
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	*.25¾*	.31
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	*.32*	.41
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	*.36*	.45

Unit Prices From Current Construction

Concrete Bridge in Washington State

DIRECTOR of highways, Olympia, Wash., awarded a contract on Dec. 9, 1930, for a concrete bridge of eight spans over the Walla Walla River at Wallula. The bridge has seven spans of reinforced-concrete T-beam construction, one 129-ft. concrete arch, a 24-ft. roadway and two 4-ft. sidewalks. Unit prices are given of the lowest three bidders, all of Spokane: A, Colonial Building Co., 617 Hutton Bldg., (contract); B, Triangle Construction Co.; C, Morrison-Knudson Co.

	A	B	C
925 cu.yd. structure excav.	$2.00	$3.00	$2.25
710 cu.yd. conc. class A	24.00	23.00	24.00
480 cu.yd. conc. class B	23.00	24.00	23.00
130 cu.yd. conc. class D	19.00	20.00	24.00
152,000 lb. reinf. bars	.045	.05	.06
115 lb. copper seals	.80	1.00	.60
390 lb. bronze exp. plates	.70	.50	.60
35 cu.yd. riprap	3.00	4.00	4.00
Total	$39,710	$41,275	$42,84

◆

Bituminous Macadam and Asphalt Concrete in California

CALIFORNIA division of highways awarded contracts on Nov. 26, 1930, for 10.7 miles bituminous macadam between San Filipe and one mile east of Bells Station, Santa Clara County, (west central part of the state) and 6 miles asphalt concrete between Araz and Yuma, Imperial County, in the southeast corner. Unit prices are given of the principal items which are common to both jobs, submitted by the lowest two bidders on each: Santa Clara County, A, Contoules Construction Co., San Francisco (contract); B, E. C. Coats, Sacramento; Imperial County, A, V. R. Dennis Construction Co., San Diego, (contract); B, Steele Finley, Santa Ana.

	Santa Clara County		Imperial County	
Common Items	A	B	A	B
Roadway excav., uncl.	$0.30	$0.35	$0.15	$0.17
Cu.yd.	211,900		191,000	
Haul	.08	.07	.005	.005
Mile yards	480,000		950,000	
Structure excav.	.75	1.00	1.25	.75
Cu.yd.	2,805		1,692	
Structure concrete, "A"	22.00	25.00	20.00	22.00
Cu.yd.	456		260	
Reinf. steel for str.	.05	.045	.06	.05
Lb.	43,000		10,900	
Special Items				
35,300 cu.yd. gravel base	.93	1.00	....	....
20,000 tons bit. mac. surface	3.10	2.45	....	....
72,000 sq.yd. subgrade	....	....	.11	.09
29,100 ton asphalt concrete	....	....	4.20	4.65
Totals	$212,285	$214,751	$227,454	$240,239

◆

Concrete Highway in Pennsylvania

PENNSYLVANIA department of highways on Oct. 9, 1930, awarded a contract for 28,035 ft. one-course reinforced-concrete 9-7 in. pavement in Westmoreland County for $348,795. There were 49 bidders, and the spread between low and high was only 28 per cent, and between low and average 14 per cent. The largest item is 50,472 sq.yd. 9-7 in. pavement; low bid $2.55; average 49 bids $2.78. Unit prices are given of the lowest three bidders: A, Joseph Ciccone & C. Centrono, 5732 Westminster Ave., Philadelphia (contract); B, Charles Winters Construction Co., Butler, $368,487; C, Adam Eidemiller, New Alexandria, $371,932. Work includes two reinforced-concrete arch bridges and 200 ft. of approach grading.

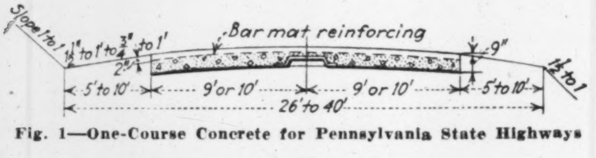


Fig. 1—One-Course Concrete for Pennsylvania State Highways

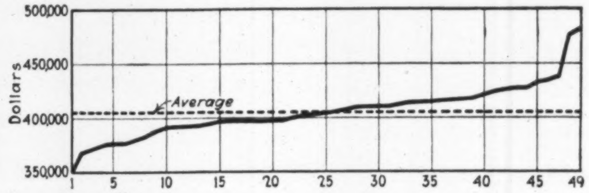


Fig. 2—Bidding Range on a $348,795 Job in Westmoreland County, Pa.

The pavement is 1:5½ fine and coarse aggregates on a weight basis, or 5¼ parts on volume. Concrete for structures is 1 : 2 : 4 for class A and 1 : 2½ : 5 for class B. Class 2 excavation is for structures.

	A	B	C
142,443 cu.yd. class 1 excav.	$0.55	$0.50	$0.58
10,152 cu.yd. class 2 excav.	.70	1.00	1.30
362 cu.yd. borrow excav.	.55	.50	1.00
Clearing and grubbing	.....	.....	.....
66,776 sq.yd. subgrade	.15	.10	.12
28,226 lin.ft. shoulders	.15	.25	.18
50,472 sq.yd. 1 C. reinf. conc. pvt. 9-7 in.	2.55	2.65	2.67
13,341 sq.yd. reinf. conc. pvt. Hes. 9-7 in.	2.70	3.00	3.15
2,750 sq.yd. bit. surf. tr. mac. surf. C. 9-7 in.	1.50	2.00	1.60
315 cu.yd. class A conc.	23.00	25.00	25.00
2,093 cu.yd. class B conc.	18.00	21.00	17.50
600 sq.yd. membrane waterproofing	1.00	.50	1.25
60,579 lb. plain steel bars	.07	.07	.05
98 lin.ft. cast-iron pipe 16 in.	3.50	3.00	3.75
65 lin.ft. cast-iron water pipe class A, 18 in.	4.00	4.00	4.25
90 lin.ft. cast-iron pipe 24 in.	5.50	7.00	6.00
Reinforced-concrete pipe:			
3,077 lin. ft., 15 in.	2.00	2.50	2.50
722 lin.ft., 18 in.	2.25	3.00	2.90
242 lin.ft., 24 in.	4.00	4.00	3.80
74 lin.ft., 30 in.	8.00	6.00	6.00
218 lin.ft., 36 in.	9.00	8.00	7.00
70 lin.ft., 54 in.	15.00	20.00	16.50
8,250 lin.ft. tile underdrain 4 in.	.80	.80	.70
Total	$348,795	$368,488	$371,932

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Pavement and Bridge in San Diego, Calif.

SAN DIEGO, Calif., common council on Dec. 1 awarded a contract for the improvement of First St. The work includes 27,917 sq.ft. of 6-in. asphaltic concrete pavement, 1,986 sq.ft. of 6-in. concrete pavement, corrugated-iron pipe and a concrete bridge.

Nine bids were received (average $35,289) all from local contractors, and unit prices are given of the lowest three: A, R. E. Hazard Contracting Co., 2548 Kettner Blvd., San Diego (contract); B, Gutleben Brothers; C, Daley Corp.

	A	B	C
884 cu.yd. excavation	$0.50	$0.20	$0.25
1,429 cu.yd. foundation excavation	1.00	1.50	1.00
11,281 cu.yd embankment	.80	.45	.80
28,950 sq.ft. subgrade	.01	.01	.01
27,916.82 sq.ft. asphalt pavement	.20	.11	.109
1,985.80 sq.ft. concrete pavement	.22	.17	.193
3,823.22 sq.ft. sidewalk	.17	.15	.163
1,132.16 lin.ft. curb	.60	.48	.47
9 water services	20.00	15.00	15.70
1 curb inlet, 6 ft.	100.00	25.00	35.00
1 curb inlet, 20 ft.	175.00	125.00	133.00
56.5 lin.ft. culvert, 12 in. corr. iron	3.00	1.80	1.95
128.3 lin.ft. culvert, 18-in. corr. iron	4.00	3.60	2.35
62.25 lin.ft. culvert, 24-in. high-strength	5.00	3.00	2.95
277.49 cu.yd. concrete, in wall, C	30.00	18.00	17.50
10.15 cu.yd. concrete, in wall, D	20.00	14.60	8.50
198.79 cu.yd. concrete, in piers, B	30.00	17.00	14.00
410.44 cu.yd. concrete in piers, C	25.00	19.00	16.70
15.00 cu.yd. concrete, in piers, D	30.00	14.60	8.50
571.42 cu.yd. concrete, in deck, C	25.00	23.00	27.10
1,047.56 lin.ft. metal rail	5.00	7.25	6.40
(137 lin.ft.) (complete) railing	200.00	220.00	312.00
(7) (complete) ornamental lights	1,200.00	1,800.00	1,667.50
(520.6 ton) (complete) structural steel	57,700.00	77,000.00	75,653.78
Totals	$123,809	$129,544	$130,981

Gravel Surfacing in Montana

THREE contracts were awarded in November, 1930, by the state highway commission of Montana for grading 36.337 miles. Contract unit prices are given of the items common to the three jobs. The contractors are: F. A. Project 156-A, Custer County, (A) Prahl & Sawtell, Miles City, $59,927; 257-B, Flathead County, (B) James Crick, Spokane, $77,157; 263-A, Lincoln County, (C) Sutherland & Burns Construction Co., Missoula, $91,501.

	A	B	C
Unclassified excav	$0.18	$0.25	....
Cu.yd	(267,656)	(189,993)	....
Overhaul	.02	.04	$0.025
Sta.yd	(64,280)	(68,740)	(93,920)
Structure excav	.25	2.00	1.00
Cu.yd	(340)	(39)	(378)
Corrugated metal pipe culvert			
Lin.ft. 15 in	1.00	2.00	1.25
	(370)	(96)	(294)
18 in	1.15	2.50	1.50
	(718)	(348)	(1,766)
24 in	1.80	3.00	2.50
	(830)	(848)	(396)
30 in	2.25	......	4.00
	(426)	......	(44)
36 in	3.70	6.00	5.50
	(624)	(52)	(142)

Three other contracts were awarded in the same month for gravel surfacing 36.917 miles of road. Contract unit prices and the contractors are: F. A. Projects 229-E and 220-B, Fergus and Toole and Glacier counties, (A) and (B) Goble Construction Co., Rapid City, S. D., $22,164 and $67,417; F. A. P. 256-C, Fergus County, (C) Basin Construction Co., Lewiston, Mont., $18,309.

	A	B	C
Crushed gravel, top course	$1.00	$1.35	$0.99
Cu.yd	(9,268)	(19,763)	(7,418)
Crushed gravel, base course	1.00	1.35	.99
Cu.yd	(11,122)	(23,664)	(8,902)
Binder	.12	.12	.02
Cu.yd	(1,400)	(3,000)	(1,100)
Overhaul on binder	.12	.12	.02
Cu.yd	(1,400)	(4,500)	(1,100)
Wire cable guard rail	.40	.40	.425
Lin.ft	(1,346)	(12,800)	(2,860)
Stock piled gravel	1.00	1.25	.94
Cu.yd	(900)	(1,900)	(950)

◆

Concrete Road in Louisiana

CONTRACT 3601-A, a 14.823-mile section of the Baton Rouge-New Orleans state highway awarded Nov. 25, 1930, is now under construction. Work consists of embankment and a 20-ft. pavement between the St. James-St. Johns parish line and the Bonnet Carré spillway. The principal item, 171,321 sq.yd. of type B concrete pavement, amounts to 59 per cent of the contract price. Contract unit price was $1.71 per square yard; the average of the twelve bids was $1.88. Unit prices are given of the lowest three bidders: A, Stevens Bros., Miller-Hutchinson Co., Sellers, La., $499,346 (contract); B, Forcum James, W. R. Aldrich Co., $516,036; C, Lawrence Construction Co., $521,750.

	A	B	C
31.735 acres clearing	$60.00	$30.00	$50.00
13.968 acres grubbing	60.00	70.00	100.00
4,400 cu.yd. drainage excav	.30	.30	.35
12,183 cu.yd. roadway excav	.22	.25	.30
405,783 cu.yd. borrow	.22	.26	.25
36,000 sta.yd. overhaul	.02	.02	.10
1,566 sta. barbed wire fence	8.00	6.50	7.00
307 sta.yd. sodding	5.00	2.50	3.00
241,788 cu.yd. pressure jetting embank	.03	.03	.04
171,321 sq.yd. concrete	1.71	1.76	1.75
1,332 lin.ft. 24-in. conc. pipe	2.50	2.50	2.50
7,605 lin.ft. 30-in. conc. pipe	3.80	3.50	3.50

◆

Highway Bridge Approach Work in Massachusetts

THREE highway approach jobs were awarded Oct. 28, 1930, by the Massachusetts department of public works. Average total prices of all bidders on each job and the contract unit prices on the items common to the three jobs are given in the accompanying tabulation. The contractors are: bituminous-concrete in Harwich, (A) Merritt-Chapman & Scott Corp., New London, Conn., $27,611; bituminous-macadam bridge approaches in Charlemont, (B) Kelleher Corp., Turners Falls, Mass., $34,182; bituminous-macadam approaches in Buckland, (C) Thomas J. Harvey, Adams, Mass., $10,070.

	A	B	C
Excavation			
Roadway earth	$1.00	$0.50	$0.60
cu.yd	(50)	(900)	(1,550)
Bridge	2.92	......	......
cu.yd	(370)	......	......
Ledge	4.00	3.00	2.50
cu.yd	(5)	(50)	(560)
Masonry			
Plain conc. 1:2½:5	20.00	22.00	20.00
cu.yd	(2)	(11)	(13)
Reinf. conc	30.50	25.00	20.00
cu.yd	(23)	(1)	(1)
Broken stone	......	3.10	2.80
tons	......	(2,500)	(1,400)
Bituminous mat	.20	.11	.09
gal	(410)	(16,300)	(9,100)
Concrete curb	1.10	1.25	1.50
lin.ft	(960)	(200)	(420)
Fine grading and rolling	.05	.05	.05
sq.yd	(3,800)	(15,500)	(5,100)
Reinf.-conc. structures	.06	.10	.06
lb	(4,650)	(110)	(110)
Trench excav	1.00	1.50	1.15
cu.yd	(100)	(350)	(100)

◆

Sand-Clay Road in South Carolina

CONTRACT was awarded in October, 1930, for grading and surfacing with sand-clay 12.4 miles of route 33 from Tillman to Beaufort County line, South Carolina. Sixteen bids were received; unit prices are given of the three lowest bidders: A, Hooper Construction Co., Bunnell, Fla. (contract); B, Boyle Road & Bridge Co., Sumpter; C, McDougald Construction Co., Atlanta.

	A	B	C
400,000 cu.yd. common excav	$0.17½	$0.19½	$0.20½
1,390 cu.yd. excav. for structures	1.50	2.00	1.00
50,000 cu.yd. sta. overhaul	.01½	.01½	.01½
65.05 M. lin.ft. finished earth-graded road	20.00	10.00	25.00
959 cu.yd. class A conc	22.00	20.00	20.00
34 cu.yd. class B conc	22.00	20.00	20.00
101,841 lb. reinf. steel	.04½	.04½	.04½
778 lin.ft. 18-in. reinf.-conc. pipe	1.75	2.00	2.25
249 lin.ft. 24-in. reinf.-conc. pipe	2.50	3.00	3.00
1,500 tons riprap	3.50	3.50	4.00
3,102 lin.ft. untreated timber piles	.50	.40	.45
Total	$125,848	$125,916	$128,601

◆

Site- and Ready-Mixed Concrete in Delaware

CONTRACT 144A for 0.30-mile Delaware state highway, bids received Dec. 16, 1930, includes bids on both job-mixed and ready-mixed concrete. Ten bids were received, and average unit prices are given as well as the prices of the lowest three: A, D. E. O'Connell & Sons, Ridley Park, Pa., $19,145 mixed in place and $18,635 central mix; B, Hill Construction Co., Mount Holly, N. J., $20,929 and $20,425; C, W. H. Hollingsworth, Wilmington, Del., $20,812 and $20,965.

	A	B	C	Avg. of 10 Bids
450 cu. yd. dry excav	$0.50	$0.100	$1.10	$0.86
4,000 cu. yd. borrow	.45	.55	.63	.58
500 cu.yd. wet excav	1.00	3.75	2.00	3.025
510 cu.yd. class "A" conc. (mixed on job)	20.00	18.19	16.20	22.339
or				
510 cu.yd. ready mixed C. A. conc	19.00	17.20	16.50	21.07
15,000 lb. reinf	.06	.0425	.06	.057
1,500 lb. grating castings	.08	.10	.20	.10
50 lin.ft. 12-in. C. I. pipe	3.00	2.40	3.00	3.115
150 lin.ft. 24 in. R. C. pipe	3.00	3.70	3.50	3.77
3 M. ft. B. M. sheet piling	100.00	55.00	120.00	98.50

◆

Grading and Paving in Kansas

KANSAS state highway department awarded contracts Sept. 5, 1930, for 15.86 miles grading and concrete paving on four federal aid projects on U. S. road 40, totaling $345,714. Unit prices are given of the successful contractors: 203A, 1.524 miles and 203B, 3.692 miles, Pottowatomie County, (A) and (B), are J. A. Tobin, 7601 Myrtle Ave., Kansas City; 355I, 5.516 miles and 355J, 5.132 miles, Shawnee County. (C) Koss Construction Co., 2818 Fifth Ave., Des Moines.

	A 203A	B 203B	C 355I	D 355J
Fine grading excav	$0.40	$0.40	$0.28	$0.28
Cu.yd.	(4,654)	(11,762)	(8,912)	(8,554)
Concrete, fine and coarse agg	1.61	2.03	1.86	1.88
Sq.yd.	(15,967)	(38,658)	(57,771)	(54,069)
Concrete, sand and stone	1.97	1.67	1.73	1.76
Edge curb, fine and coarse	.10	.12	.10	.10
Lin.ft.	(12,636)	(33,242)	(3,790)	(4,642)
Edge curb, sand and stone	.10	.10	.10	.10
Exp. joints	.12	.12	.10	.10
Lin. ft.	(1,260)	(3,006)	(320)	(4,212)
Jetting fills	.04	.04	.03	.03
Cu.yd.	(29,485)	(71,182)	(30,664)	(31,610)
Extra rolling	1.50	2.50	1.50	2.00
Hours	(50)	(120)	(200)	(200)
Total, fine and coarse agg.	*$35,757	$97,131	*†$114,206	*$105,583
Total, sand and stone	37,752	*91,637	119,010	111,816

*Contract price. †Less 1.2 per cent with 355J.

Grading in Washington State

THIRTY-FIVE contractors bid on grading 4.214 miles of Washington state road 3 in Walla Walla county. Average unit prices are given of all the bidders and those of the lowest three: (A) Union Construction Co., 618 Board of Trade Bldg., Portland (awarded on schedule B); B, Columbia Power & Investment Co., Inc., Stevenson, Wash.; C, Northwest Construction Co., 3506 Third Ave., N. W., Seattle.

	A	B	C	Avg. of All Bidders
Clearing and grubbing (lump sum)	$150.00	$2,500.00	$200.00	......
244,590 cu.yd. class A excav., including haul of 400 ft	.15	.16	.18	$0.216
60 cu.yd. solid rock excav., including haul of 400 ft	1.00	1.00	2.00	1.646
1,330 cu.yd. structure excav. including haul of 400 ft	.90	.90	.60	.779
750 cu.yd. class D excav. including haul of 400 ft	1.00	.75	.60	.664
612,970 cu.yd. overhaul on above materials per each 100 ft	.01	.01	.01	.012
505.53 cu.yd. Class B conc. in place	17.00	20.00	16.50	21.241
56,680 lb. steel reinf. bars in place	.065	.07	.06	.062
190.00 cu.yd. sack riprap (Class C conc.) in place	2.00	17.00	17.00	16.237
60.00 cu.yd. slab riprap (Class C conc.) in place	3.00	19.00	17.00	17.665
480 lin.ft. plain conc. or V.C. pipe 12 in. diam. in place	1.25	1.00	.85	1.068
204 lin.ft. plain conc. or V.C. pipe 18 in. diam. in place	2.50	1.75	1.65	1.881
Sub total	$58,923	$68,869	$68,461	
Schedule A				
153 lin.ft. standard reinf. conc. pipe 18 in. diam. in place	3.50	2.07	1.95	2.275
930 lin.ft. standard reinf. conc. pipe 24 in. diam. in place	4.00	2.60	2.70	3.158
Subtotal, schedule A	$4,256	$2,735	$2,809	
Schedule B (Alternate)				
153 lin.ft. corrugated iron pipe 18 in. diam. in place	1.85	1.50	1.70	1.919
930 lin.ft. corrugated iron pipe 24 in. diam in place	2.90	2.50	3.00	2.938
Subtotal schedule B	$2,980	$2,555	$3,050	
Total schedule A	$63,179	$71,604	$71,270	
Total schedule B	61,903	71,423	71,511	

Concrete Paving in Texas

CONTRACT was awarded Nov. 29, 1930, for 4.567 miles of 20-ft. reinforced-concrete pavement for state highway No. 3 in Jefferson County, Texas. Work includes grading and drainage structures. Unit prices are given of the four bidders: A, Broussard Warfield Co., Beaumont (contract); B, H. L. Cannady Co., Dallas; C, Earl Yates & Son, Edna; D, T. L. James & Co., Inc., Ruston, La.

Excavation, Cu.Yd.	A	B	C	D
21,040 uncl. roadway	$0.15	$0.25	$0.20	$0.18
2,407 dry channel	.25	.20	.20	.18
569 class A culvert	1.00	.50	.75	1.00
50 class B culvert	2.00	.60	2.00	3.00
2,276 borrow	.25	.18	.20	.18
5,490 overhaul	.05	.04	.05	.04
Concrete and Steel				
47,426 sq.yd. conc.	1.72	1.73	1.78	1.77
99,053 lb. reinf. steel for pav.	.03	.03	.03	.035
476 cu.yd. class A for structures	18.00	17.50	18.50	19.00
48,565 lb. reinf. steel for str.	.04	.045	.04	.045
Totals	$103,128	$106,350	$108,797	$110,083

Plain Concrete Road in Florida

FLORIDA state road department in November, 1930, awarded a contract for 9.92 miles of grading and plain concrete paving. Unit prices are given of the lowest three bidders: A, John J. Quinlan Co., Inc., Miami (contract), $263,164; B, Morgan-Hill Paving Co., Miami, $265,081; C, H. E. Wolfe Construction Co., St. Augustine, $266,957.

	A	B	C
5.2 acres clearing and grubbing	$50.00	$50.00	$120.00
35,268 cu.yd. regular excav	.30	.30	.32
8,974 cu.yd. lateral ditch excav	.30	.20	.35
4,128 sq.yd. 6 in. broken stone base No. 2	1.00	.72	.85
4,128 single bit. tr. using slag*	.35	.22	.25
4,128 sq.yd. single bit. tr. using cr. gravel*	.33	.22	.24
118,475 sq.yd. plain cement conc. pavement	1.79	1.85	1.82
5,778 sq.yd. reinf. conc. pavement	2.00	2.02	2.15
37.57 cu.yd. Class A conc. for culverts	20.00	20.00	22.00
1,223 lb. reinforcing steel	.05	.05	.05
6.82 M.F.B.M. treated struct. timber	100.00	90.00	110.00
0.243 M.F.B.M. untreated struct. timber	75.00	50.00	100.00
600 lin.ft. treated trestle piling	.90	.90	1.10
20 lin.ft. 15 in. reinf. conc. pipe	2.00	1.50	1.75
200 lin.ft. 18 in. reinf. conc. pipe*	2.00	2.00	1.90
200 lin.ft. 18 in. cast iron pipe*	4.00	3.00	3.25
57 lin.ft. 30 in. reinf. conc. pipe*	4.00	3.25	3.50
57 lin.ft. 30 in. cast iron pipe*	7.00	7.30	7.50
58 lin.ft. 18 in. reinf. conc. pipe*	2.00	2.00	1.90
58 lin.ft. 18 in. vitrified clay pipe*	3.00	2.00	2.25
58 lin.ft. 18 in. corrugated metal pipe*	3.00	1.25	2.00
10,392 lin.ft. comb. cem. conc. curb and gutter	.70	.60	.65
14,728 lin.ft. woven wire guard rail	.45	.42	.45
120,183 sq.yd. sprigging	.03	.02	.02
7 drop inlets complete in place	25.00	30.00	75.00
1 manhole complete in place	50.00	50.00	65.00

*Alternate bids.

Grading and Paving in Arizona

THE Tucson highway in Arizona requires 2.73 miles of grading, draining and paving. Two contracts for this work, F.A.P. 94-A and F.A.P. 1, were awarded by the state highway commission on Dec. 16, 1930, to the Stanley Jaicks Co., 1950 East Fourth St., Tucson, for $77,083. Unit prices are given of the lowest three bidders on the 94-A items, all of which are common to the other job. The bidders were: A, Miracle Construction Co., 404 Security Bldg., Phoenix; B, Stanley Jaicks Co. (lowest combined bid); C, F. W. Teschke, 30171 Cahuenga Ave., Hollywood, Calif.

	A	B	C
6,131 cu.yd. unclass. roadway excav	$0.45	$0.70	$0.25
507 cu.yd. structural excav	1.00	.80	1.00
358 cu.yd. borrow	.30	.50	.20
751 sta. yd. overhaul	.02	.05	.02
18,335 sq.yd. conc	2.16	2.12	2.35
111 cu.yd. class A conc	22.00	22.00	18.00
9,430 lb. reinf. steel	.06	.06	.05
900 lin.ft. reconst. fence	.07	.07	.05
Removing a conc. pipe	5.00	50.00	20.00
	$46,068	$46,906	$47,749

Unit Prices on Concrete Highway Bridges

Issued by U. S. Bureau of Public Roads, Week of Dec. 13, 1930

State, County	Total Bid	Reinf.-Conc., Cu.Yd. 1 : 2 : 4 Dollars	Reinf. Steel, Lb., Cents	Contractor
Ala., Jefferson	$41,935	1,075 $16	135,290 3.5	W. C. Howton Const. Co., Birmingham
Kan., Rooks	12,570	502 14	48,860 5.0	Yancey Const. Co., Abilene
Kan., Harvey	19,929	283 15	115,500 4.0	C. L. Ring, McPherson
Ky., Morgan	30,875	804 19	126,680 4.0	J. M. Perkind, Frankfort
Me., Aroostook	12,500	58 16	11,400 6.0	McFachern & McPherson, Greenville
Neb., Sioux	22,189	1,010 15	82,236 4.25	A. C. Smith, Scottsbluff
N. C., Columbus	11,652	391 23	59,080 4.50	J. D. Orrell, Wilmington, N. C.
Ore., Tillamook	38,857	600 20	185,000 4.50	Clackamas Const. Co., Oregon City
Tex., Leon	19,307	536 18	87,056 4.0	E. E. Board & Son, Cleveland, Tex.

CONSTRUCTION NEWS

Some of the Week's Large Projects

For further details turn to the appropriate sections in this issue

Location	*Project*	*Cost*	*Status*
Waterworks			
Phoenix (Ariz.)	Pipe line and reservoir	$2,059,140	Contract
Sewers			
Illinois	Sewage treatment plants	1,200,000	Proposed
Montreal	Trunk sewer	2,450,000	Proposed
Bridges			
Chicago	Viaduct and bridges	4,349,668	Contract
Streets and Roads			
Chicago	Paving	3,721,000	Bids asked
Unclassified			
Colorado	Gas pipe line	3,000,000	Proposed
Hamilton (Ont.)	Track elevation and depot	3,000,000	Bids asked
Seattle	Transmission line	2,500,000	Proposed
Buildings			
New York	Cathedral	1,300,000	Contract
Brooklyn	Nurses' home, etc	1,625,000	Proposed
Paterson (N. J.)	Hall of Records	3,500,000	Proposed
Trenton	State house	2,000,000	Proposed
Nashville	Theatre	1,250,000	Proposed
Los Angeles	Publishing plant	3,500,000	Proposed

WATERWORKS

PROPOSED WORK

Calif., Exeter—For 200,000 gal. storage tank, drilling well, deep well pump, extending mains. I. H. Althouse Porterville, engr.

Calif., Pasadena—For 4 m.g. reservoir on Allen Ave. site. $40,000. S. B. Morris, ch. engr. Water Dpt.

Calif., Sacramento—New sedimentation basin at municipal filtration plant To exceed $25,000. F. J. Klaus, city engr.

Conn., Hartford—City, Bd. Contr. & Supply, 50 new hydrants, $8,750; 75 renewals, $11,250.

Ky., Lawrenceburg — City pipe line to Kentucky River, pumping machinery, filter beds. $80,000. H. K. Bell, Lexington, engr.

Mass., Yarmouth—Town, water distribution system. $75,000 appropriated.

Minn., Moorhead—Installing 16 in. main to connect wells with northeast portion city. $40,000. R. G. Price, city clk.

Okla., Lawton — City postponed indefinitely taking bids for settling basins, storage basins, filter tubs and other structures comprising purification and pumping station; filter equipment, piping, valves, sand, gravel, operating tables, gages, clarifiers, chemical equipment; 7 motor-driven centrifugal pumps, three-panel switchboard and electrical equipment; flow lines, force mains, distribution system improvements, incl. 13,000 ft. 24 in. main to filter plant; furnishing, erecting 400,000 or 500,000 gal. steel tank, 130 ft. to overflow and 100,000 gal. steel tank, 32 ft. to top of riser; hydrants, valves and boxes. $550,000. F. E. Lawrence, city engr. Burns & McDonnell Eng. Co., 407 Interstate Bldg., Kansas City, Mo., engrs. Noted Dec. 4.

BIDS ASKED

Calif., Daly City—City Clerk taking bids excavating for 1 m.g. storage reservoir, incl. 6,000 cu.yd. grading.

Calif., Ontario—Jan. 5, by D. B. Wynne, city clk., furnishing, installing centrifugal booster pump in Pumping Plant 6.

Ind., Marion—See "Contracts Awarded."

Minn., Minneapolis—Jan. 5, by F. S. Gram, city purch. agt., furnishing, installing 1 pump, motor, $15,000; furnishing 48,000 lin.ft. 6 in., 14,000 ft. 8 in., 3,200 ft. 12 in. and 2,000 ft. 16 in. centrifugally cast and o.s. cast iron water pipe; 30 tons special castings; 3,600 tons alum for filtration plant. N. W. Elsberg, city engr.

Minn., Minneapolis—Jan. 8, by F. S. Gram, city purch. agt., 225 six in., 25 eight in. and 6 twelve in. gate valves, 100 fire hydrants. N. W. Elsberg, city engr.

N. J., Hammonton—Jan. 8, by Bd. Water Comrs., M. E. Wilson, secy., 14,333 ft. 6 and 8 in. c.i. pipe, appurtenances. J. A. Baker, town engr.; adv. E. N.-R. Jan. 1.

N. Y., Long Beach—Jan. 13, by City Council, J. J. McCabe, clk., City Hall, Park Ave., two 750,000 gal. tanks or reservoirs; adv. E. N.-R. Jan. 1.

N. Y., Long Island City—Jan 6, by J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, steel and c.i. mains, appurtenances in Alley Pond Park and Pumping Station 8, Nassau and Kissena Blvds., Main and 158th Sts., Cherry, Elder and 43rd Aves., Queens Boro.

N. Y., New York—Jan. 9, by J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., mains in East 235th and East 240th Sts., Mosholu, Katonah and McLean Aves., Bronx Boro.

Wash., Foster—Miller Eng. Co., engrs., Burke Bldg., Seattle, bids about Jan. 10, supply line from Seattle's Cedar River supply line, and installing 2- to 6-in. steel or c.i. distribution system, for Water Dist 25. $25,000.

Wash., Seattle—Bd. P. Wks., bids about Jan. 11, c.i. main in East 65th St. from 20th to 45th Aves. N. E. $50,000. R. H. Thomson, city engr.

CONTRACTS AWARDED

Ariz., Phoenix — For 25 mi. 45- to 54-in. centrifugal cast rein.-con. supply line, 20 m.g. concrete reservoir, to Schmidt & Hitchcock, 11th and Jackson Sts., Phoenix, Ariz., and to Amer. Concrete Pipe Co., 542 South Bway., Los Angeles, Calif. and Phoenix, Ariz., $2,059,140. Noted Nov. 20.

Calif., Beverly Hills—City Council 5,050 ft. 14 in. Class A and B c.i. pipe line in Maple Dr. and laying 8- to 16-in. pipe lines to City Water Treatment Plant 2, to M. Matick, 1436 West 51st St., Los Angeles, $14,700 and $10,800 respectively; furnishing, installing equipment for Water Treatment Plant 2, to International Filter Co., 108 West 6th St., Los Angeles, $19,755. Grand total $45,255. Noted Dec. 4.

Calif., Long Beach—City, 30,000 ft. 2 in. B. and S. c.i. pipe, to Grinnell Co. of the Pacific, 520 Mateo St., Los Angeles, $16 per 100 ft.

Ind., Ft. Wayne—Bd. P. Wks., 1,000 tons 24 in. c.i. pipe, to J. B. Clow, North Talman Ave. and West Lake St., Chicago, Ill., $43,300. Est. $50,000.

Ind., Marion—City Council, 1.4 mi. mains, own forces. $15,000. S. M. Van Cleave, Marion, engr. Noted Dec. 18.

Neb., Rushville—Waterworks improvements, to Gordon Constr. Co., 31st St. and Platte River, Denver, Colo., $4,000; pipe, to McWane Cast Iron Pipe Co., 3700 11th Ave. N., Birmingham, Ala., $6,998; hydrants, to Warner Co., Denver, Colo., $560. Grand total $11,558. Noted Nov. 13.

N. Y., St. George—J. J. Deitz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in Acacia Ave., to Substructures Co., 1473 Richmond Terrace, Port Richmond, $9,685. Noted Dec. 18.

Okla., Tulsa—E. Logan, city aud., new pumping station, to Standard Paving Co., 2119 East 11th St., $44,000. Est. $50,000. Noted Dec. 4.

SEWERS

PROPOSED WORK

Illinois — North Shore Sanitary Dist., Waukegan, new treatment plants for Winthrop Harbor $38,500, Waukegan $736,000, Highland Park $160,000; additional units at present plants in North Chicago $124,000, Lake Forest $47,500, Highwood $93,500. J. Anderson, Jr., Lake Forest, J. Oliver, Highland Park, D. T. Webb, Waukegan, W. Atkinson, North Chicago, and J. F. Bidinger, Waukegan, dist. trustees. Pearce, Greeley & Hansen, 6 North Michigan Ave., Chicago, engrs. $1,200,000 bonds voted.

Ill., West Frankfort — Preliminary plans sewerage system, disposal plant. $383,000.

Ind., Bloomington—City Council sewage disposal plant. Pearse, Greeley & Hansen, 6 North Michigan Ave., Chicago, Ill., engrs.

Ont., St. Catherines—City Council, 3.5 mi. 10- to 18-in. vitr. clay storm sewers. $50,000. B. F. Lamson, city engr.

Ont., Toronto—East York Twp. 1 mi. 8 and 12 in. vitr. clay relief sewer from Pottery Rd., to Broadview Ave. at Gamble Ave. $27,000. G. R. Jack, 443 Sammon Ave., engr.

Que., Montreal—City Executive bids early in January, 5 mi. or more Mont Royal Trunk Sewer, $2,450,000, of which $199,317 will be paid by city of Outremont.

BIDS ASKED

Ala., Troy—Jan. 15, by State Hy. Comn., Montgomery, 150 ft. concrete, steel bridge, Rd. 53.

La., Donaldsonville — Jan. 26, by S. A. Marchand, mayor, complete sanitary sewerage system, incl. 12 mi. 8- to 12-in. main and lateral sewers, 22,500 lin.ft. house sewer connections, 5,550 ft. 12 in. c.i. pipe outfall, complete raw sewage pumping station.

Mich., Ann Arbor—Jan. 14, by F. C. Perry, city clk., 26,411 ft. 42 in. pipe, 40 x 48 in. brick sewer in tunnel, 12- to 30-in. concrete or vitr. pipe, for Main Trunk Sanitary Sewer. $350,000. G. H. Sanderburgh, City Hall, engr.

Mich., Flint—Jan. 15, by City Clerk, sewage treatment plant, Contr. S. D. 6, incl. aeration tank and blower building, trickling filters, final settling tanks and chlorination building, piping, drainage, etc. Hoad, Decker, Shoecraft & Drury, Ann Arbor, consult. engrs.; adv. E. N.-R. Jan. 1.

N. Y., Freeport — Jan. 12, by Bd. Sewer Comrs., Municipal Bldg., 46 North Ocean Ave., sanitary sewers for Lateral Sewer Dist. 2. Baldwin & Cornelius Co., Inc., village engrs. Clyde Potts, 30 Church St., New York, consult. engr.; adv. E. N.-R. Jan. 1.

N. Y., Long Beach—Jan. 13, by City Council, J. J. McCabe, city clk., City Hall, Park Ave., extending sewage disposal plant; adv. E. N.-R. Jan. 1.

N. Y., St. George—See "Streets and Roads."

Pa., Phila.—Jan. 14, by Dpt. P. Wks., Bureau Eng. & Surveys, City Hall Annex, A. Murdock, dir., Schedule A, branch sewers; Schedule B, main sewer in Bells Mill Rd. between Wissahickon Creek and Perkiomen Turnpike; Schedule C, Pennsylvania Avenue Impvt. Contr. 1, constructing walls, foundations, removing existing masonry, fabricating, erecting steel, connecting roof of subway structure, building storm sewer, grading, paving sidewalks on Pennsylvania Ave. from 26th to 27th Sts. $300,000. Noted Oct. 23.

B. C., Nanaimo—See "Contracts Awarded."

Ont., Brampton—See "Contracts Awarded."

CONTRACTS AWARDED

Calif., Redwood City—E. M. Kneese, clk. San Mateo Co., 6- to 15-in. clay and 8- to 14-in. c.i. sewers, 330 manholes, concrete sedimentation tank, two 400, two 500, one 140 g.p.m. pumps, in Colme and Daly Sts., to W. J. Tobin, 427 Balfour St., Oakland, $108,394. Noted Dec. 4.

Ind., Indianapolis — Bd. P. Wks. sanitary sewer from Belmont and 10th Sts. to 18th and Rowland Sts., for U. S. War Veteran's Hospital, to Sheehan Constr. Co., 207 Holliday Bldg., $26,261. Noted Nov. 20.

N. Y., New Rochelle—Westchester Co. Sanitary Sewer Comn., White Plains, trunk sewer Sect. X, Mamaroneck Project, to A. W. Bryne & Son, 79 Linnmoore St., Hartford, Conn., $52,671. Noted Dec. 4.

N. Y., New York—H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., sewers in Ampere Ave., to Nabrum, Inc., 2556 Wallace Ave., $106,350. Noted Dec. 11.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., altering and improving sewer in Mercer St., to Melrose Constr. Co., 103 East 125th St., $10,072. Noted Dec. 11.

N. Y., Yonkers — Westchester Co. Sanitary Sewer Comn., E. S. Martin, secy., White Plains, 2 mi. trunk sewer from Lake Ave. to Locust St., to Montrose Contg. Co., Grand Central Terminal, New York, $985,000. Noted Dec. 4

See proposal advertising on page 221

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72-in. cast iron bell and spigot pipe line . . . Jointed with LEADITE

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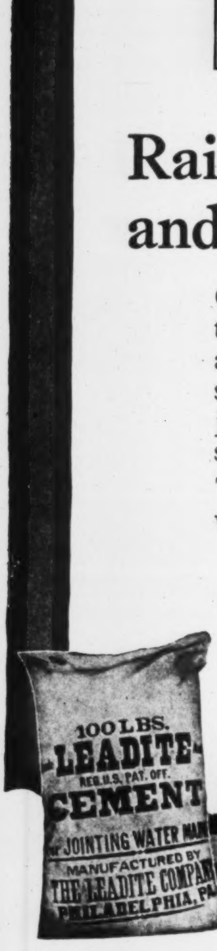

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Sewers (Continued)

N. Y., Watertown—Western Outfall Sanitary Sewer, to Burns Bros. & Haley, Inc., Watertown, $101,606. Noted July 17.

O., Canton—City, storm water sewer in Bryan Ave. S. W., from Navarre Rd. S. W., south to corporation line, to Garaux Bros. Co., 415 9th St. S. W., $25,872. Est. $30,000.

O., Cincinnati—Hamilton Co., 11,249 ft. 8- to 48-in. vitr. clay sewers in Sanitary Sewer 52, Dist. 4, to J. R. Crew, 3810 Regent Ave., Norwood, $32,294. Est. $46,129.

O., Cleveland—For 3,111 ft. 24 in. vitr. clay intercepting sewer from sewage tank near West 117th St. to Cooley Ave., to Haddad-Mall Co., Hanna Bldg., $28,469.

Utah, Ogden—Storm sewer in 24th St. from Washington to Wall Aves., to Wheelwright Constr. Co., Ogden, $45,143. Est. $45,500. Noted Dec. 4.

B. C., Nanaimo — Vitr. sewers, day labor under supervision A. G. Graham, engr., City Hall. $34,000.

Ont., Brampton—City Council, sewage disposal plant and trunk sewer, day labor, $145,000, F. A. Dallyn, 71 King St. W., Toronto, engr.; 27- to 36-in. tile, awarded to United Supply Co., Brampton. Noted Nov. 13.

WASTE DISPOSAL

PROPOSED WORK

N. J., Closter—Boro Council, Boro Hall, will not build incinerator. This corrects report in Dec. 4 issue.

BIDS ASKED

Minn., Minneapolis—Jan. 5, by F. S. Gram, city purch. agt., 50 steel tanks for garbage department; rein.-con. sewer pipe, various sizes, seasons supply. N. W. Elsberg, city engr.

BRIDGES

PROPOSED WORK

Mo., Boonville—Missouri, Kansas & Texas R.R. Co., F. Ringer, ch. engr., Railway Exch. Bldg., St. Louis, bids in spring, superstructure bridge over Missouri River and Missouri Pacific tracks. This corrects report in Dec. 25 issue.

New York — Dpt. P. Wks., A. W. Brandt, comr., Albany, bridge across Hudson River from Catskill to Hudson. G. B. Woodruff, 370 Lexington Ave., New York, acting as consult. engr. to Dpt. P. Wks., Albany. Noted Nov. 13.

BIDS ASKED

Calif., Santa Rosa—Jan. 13, by Clerk Sonoma Co., 140 ft. riveted steel bridge over Sonoma Creek, near Sonoma State Home, incl. 185,000 lb. structural steel, 22,500 lb. reinforcing steel, 2,500 cu.yd. approach fills. E. A. Peugh, Santa Rosa, co. surv.

Florida—Jan. 12, by State Road Dpt., Tallahassee, 64 ft. concrete bridge, 6 mi. west of Pensacola Rd. 1, Project 879, Escambia Co.—bridge to have 169 ft. steel span on concrete piers, nine 30 ft. rein.-con. deck girder approach spans over Suwannee River, Federal Aid Project 67, Rd. 50, Suwannee and Hamilton Counties. H. M. Duncan, hy. engr.

Ind., Michigan City—Jan. 17, by Bd. Comrs. Laporte Co. (Paporte), bascule bridge over Harbor. $300,000. E. L. Alexander, Lâporte, engr.; adv. E. N.-R. Jan. 1.

Indiana and Illinois — Jan. 20, by Indiana State Hy. Comn., Indianapolis, J. J. Brown, dir., and Illinois Dpt. P. Wks. & Buildings, Div. Hys., Springfield, F. T. Sheets, ch. engr., open spandrel arch bridge with 80 ft., 145 ft., 170 ft., 180 ft., 170 ft., 145 ft. and 70 ft. spans beginning on Indiana side, 22 ft. roadway between curbs, two 5 ft. sidewalks over Wabash River on U. S. Rd. 50 from Vincennes, Knox Co., Ind. to Lawrence Co., Ill.

Ia., Des Moines—See "Contracts Awarded."

Michigan—Jan. 6, at office J. T. Sharpensteen, div. engr., Escanaba, M Br. 1 of 75-7-12, Contrs. 1 and 3, 2 rein.-con. abutments, steel deck girder, Schoolcraft Co., for State Hy. Comn., Lansing.

Michigan—Jan. 7, at office A. L. Burridge, div. engr., Cadillac, M Br. 1 of 43-11-2, Contrs. 3 and 4, 2 rein.-con. abutments, steel deck girder, rein.-con. flooring, Lake Co., for State Hy. Comn., Lansing.

Michgian—Jan. 7, at office A. L. Burridge, div. engr., Cadillac, F. A. Br. 1 of 51-7-6 Contrs. 1 and 3, 2 rein.-con. abutments, steel deck girder, with rein.-con. flooring, railing, Manistee Co., for State Hy. Comn., Lansing.

Miss., Holly Springs—Jan. 6, by Bd. Supervs. Marshall Co., 300 ft. pile bridge on Chulahoma-Byhalia Rd.—166 ft. pile bridge on Wade Hill-Byhalia Rd.—60 ft. pile bridge over Wildcat Creek south of Mt. Pleasant, Dist. 2—5,000 ft. bridge lumber for Dist. 4.

New Jersey and Pennsylvania — Jan. 5, by Joint Comn. for Elimination of Toll Bridges over Delaware River, L. Focht, engr., State Bldg., Trenton, N. J., replacing 4 wooden spans with 4 steel spans and strengthening existing steel spans on bridge over Delaware River between Frenchtown, N. J., and Uhlertown, Pa. $125,000.

Texas—State Hy. Comn., W. R. Ely, chn., Austin, bids Jan. 19 or 20, steel I-beam bridges, over San Miguel, Lagunaville and Live Oak Creeks, Hy. 97, State Aid Project 628-D, Atascosa Co. G. G. Wickline, Austin, bridge engr.

West Virginia—See "Streets and Roads."

CONTRACTS AWARDED

Arizona—See "Streets and Roads."

Ill., Chicago—Bd. Local Impvts., City Hall, Ogden Avenue Impvt., incl. viaduct over Goose Canal, with 78 ft. roadway, two 15 ft. sidewalks, two 200 ft. bascule bridges, with 60 ft. roadway and two 15 ft. sidewalks, one over North Branch other over Ogden River, to Great Lakes Dredge & Dock Co., 104 South Michigan Ave., $4,349,668. Est. $5,460,000. Noted Dec. 11.

Ind., Richmond — Bd. Comrs. Wayne Co., Court House, 726½ ft. rein.-con. bridge, 47 ft. wide, with 32 ft. center roadway, two 6 ft. sidewalks over Whitewater River, South G. St., to I. E. Smith Constr. Co., Richmond, $198,845. Est. $272,000. Noted Dec. 4.

Ia., Des Moines—Des Moines Union Ry., A. L. Morgan, ch. engr., altering, strengthening bridge over Des Moines River between Vine St. and Court Ave., own forces. $30,000.

New Jersey—State Hy. Comn., Trenton, bridge across Musconetcong River, Hunterdon and Warren Counties, to Kaufman Constr. Co., 26 South 15th St., Phila., Pa., $48,966. Noted Dec. 18.

N. J., Blairstown—State Hy. Comn., Trenton, bridges, approaches on 0.443 mi. Warren Co., to Hill Constr. Co., Mount Holly, $185,212. Noted Dec. 4.

Okla., Thomas — Custer Co. (Arapahoe), 9 span, 1,110 ft. steel truss bridge on concrete piers over South Canadian River, near here, to Nims & Frost, Hydro, $340,990. Est. $400,000. Noted Dec. 4.

STREETS AND ROADS

BIDS ASKED

Arizona — Jan. 5, by State Hy. Comn., Phoenix, grading, bridging, placing subgrade stabilizer on 1.3 mi. Yuma-Phoenix Hy., and 13.7 mi. Globe-Stafford Hy. W. W. Lane, state hy. engr.

Calif., Tujunga—City Council, rejected bids Sept. 10, grading, curbing, guttering, street lighting 6- to 9-in. concrete paving 138,000 sq.yd. Michigan Ave. $91,938. Noted Aug. 28.

Connecticut—Jan. 5, by J. A. Macdonald, hy. comr., Hartford, rein.-con. paving 87,114 ft. hys. in Chaplin, Eastford, Manchester, New Milford, Washington and Stamford — grading, native gravel surfacing 14,862 ft. hys. Washington and Litchfield — grading, drainage 14,505 ft. Milford—grading 7,055 ft. Saybrook—bituminous macadam paving 7,490 ft. East Windsor — waterbound macadam 26,250 ft. Canterbury, Lisbon—trap rock waterbound macadam paving 1,200 ft. Sharon—rein.-con. bridge, approach, Litchfield—concrete encased plate girder bridge, approaches, Thompson; adv. E. N.-R. Jan. 1.

Florida—Jan. 12, by State Roads Dpt., Tallahassee, single bituminous surface treated on 8 in. Florida lime rock compacted base surfacing 76,267 sq.yd. Project 892, Rd. 30, Indian River Co. B. M. Duncan, hy. engr.

Illinois—Jan. 6, by State Dpt. P. Wks. & Buildings, Div. Hys., Springfield, concrete paving 2.63 mi. Route 57, Sect. 571W-1, 40 ft., Cook Co. F. T. Sheets, ch. hy. engr. State furnishes cement.

Ill., Chicago—Jan. 12, by Bd. Comrs. Cook Co., County Bldg., improving and paving 2.7 mi. Greenwood Blvd.—1 mi. River Rd.—2.5 mi. Higgins Rd. 2.5 mi. Forest Reserve Rd.—5.1 mi. Wolf Rd.—5.1 mi. Willow Rd. 1.8 mi. Talcott Rd. 1.9 mi. 55th St.—0.7 mi. Carpenter St.—0.3 mi. Vermont St.—0.5 mi. 87th St. from Western to Damen Aves.—3 mi. 87th St. from Cicero to Western Aves.—0.8 mi. Halsted St.—3.3 mi. Oakton St.— 1 mi. Beverly Ave.—0.8 mi. Foster Ave. from Milwaukee Ave. to Higgins Rd.—1.6 mi. Foster Ave. from Elston to Central Park Aves.—0.4 mi. Montrose Ave.—1 mi. Kedzie Ave.—0.7 mi. Fullerton Ave.—2.7 mi. Indiana Ave.—1.3 mi. 1st Ave. from Joliet Rd. to Ogden Ave.—2 mi. 1st Ave. from Chicago to Fullerton Aves.—2 mi. Crawford Ave. —1.6 mi. Harlem Ave. from Milwaukee Ave. to Dempster St.—3.8 mi. Harlem Ave. from Lincoln Hy. to 183rd St.—1.9 mi. Harlem Ave. from Joliet to Archer Rds.—1.2 mi. Harlem Ave. from 63rd to 71st Sts.—4 mi. Toughy Ave.—1.4 mi. Lake Ave.—3 mi. Cottage Grove Ave.—0.6 mi. Dearlove Ave. Chicago Ave. from 1st Ave. to Thatcher Rd. — bridge on Southwest Hy. over Sag Channel—culvert in Ridgeland Ave. $3,721,000. G. A. Quinlan, 221 North La Salle St., engr.

Kansas—Jan. 6, by State Hy. Comn., Topeka, at Court House Ness City. **(F.A.P. means Federal Aid Project)** sand gravel or chats surfacing 5.605 mi. Project 160-13, F.A.P. 411-A—6.351 mi. Project 160-13 F.A.P. 411-B, both Clark Co.—17.312 mi. Project 54-11, F.A.P. 472-B, Ford Co.—16.019 mi. Project 96-1 Kansas Project 1141—10.226 mi. Project 96-2 F.A.P. 397-A, both Greeley Co.—18.845 mi. Project 96-9, F.A.P. 279-B—18.845 mi. Project 96-10 F.A.P. 398-C—5.205 mi. Project 96-10 F.A.P. 398-D, all Ness Co. W. V. Buck, hy. engr.

Kan., Hays—Jan. 6, by City, H. W. Oshant, mayor, grading, curbing, guttering, storm sewers, 2½ in. brick, ¾ in. sand cushion on 4 in. concrete base, 6 in. concrete, or 6 in concrete armourplate surfacing 24,656 sq.yd. E. T. Archer & Co., New England Bldg., Kansas City Mo., engrs.

Miss., Oxford—Jan. 6, by Bd. Supervs. Lafayette Co., gravel surfacing 3.442 mi. College Hill Spur.

Miss., Walthall—Jan. 5, by Webster Co. Hy. Comn., Separate Road Dist. A, gravel surfacing 3.55 mi. road from Malheston running thence west north of Columbus & Greenville R.R., Project 19.

New Jersey—Jan. 12, by State Hy. Comn., Trenton, grading, 9 in. single line rein.-con. paving 0.58 mi. Route 23, Sects. 6A, 7A, 7B, at Beaver Lake, Oak Ridge and Newfoundland, Sussex and Passaic Counties; 8 in. single line rein.-con. paving 8.06, mi. Route 42, Sect. 5, from Gloucester Co. Line to Weymouth, Atlantic Co. A. L. Grover, ch. engr.; adv. E. N.-R. Jan. 1.

N. Y., New York—Jan. 7, by H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., grading, curbing, sidewalks on Oakley St., Commonwealth, Chesbrough and Wilder Aves.; sewers in Waring, Mickle, Mace, Throop and Young Aves.

N. Y., St. George—Jan. 7, by J. A. Lynch, pres. Richmond Boro, Boro Hall, grading, concrete paving widened roadway area Arthur Kill Rd.—grading, general improvement plaza Outerbridge Crossing—and circular plot Ward and Fielder Aves.—reconstructing culvert in Midland Ave. and Victory Blvd.—relief drain in Jewett Ave.

Oklahoma—Jan. 6, by State Hy. Dpt., Oklahoma City, grading, drainage structures 6.87 mi. U. S. Hy. 62, near Muskogee, Muskogee Co. $25,000—7.867 mi. State Hy. 8, near Hinton, Caddo Co. $35,000—7.085 mi. State Hy. 9, near Hobart, Kiowa Co. $30,000—7.754 mi. U. S. Hy. 75, Hughes Co. $30,000—5.05 mi. State Hy. 18, near Meeker $25,000 and 10.18 mi. U. S. Hy. 66 near, Wellston, Lincoln Co. $25,000—5.22 mi. U. S. Hy. 64, near Haskell, Muskogee Co. $30,000 — 5 mi. State Hy. 18, Pottawatamie Co. $25,000—7.06 mi. State Hy. 11, near Claremore, Rogers Co. $30,000, all 32 ft. wide. A. R. Losh, hy. engr.

Okla., Oklahoma City—Jan. 6, by M. Peshek, city clk., sheet asphalt resurfacing 17,000 sq.yd. Robinson St. from 16th to 28th Sts. $37,000. G. F. Brown, City Hall, engr.

West Virginia—Jan. 20, by State Road Comn., Charleston, crushed stone surfacing 15 mi. Muddlety-Braxton County line Rd., Projects 159-C and D and 160, Part Project 159-A, Nicholson Co.—retread on stone surfacing 2.9 mi. Raleigh-Shady Springs Rd., Part Project 173-D and 3.4 mi. Shady Springs-Ghent Rd., Part Project 173-E, Raleigh Co. — Beckner Bridge 1220, substructure, 2 abutments, Project 3431, Ritchie Co.—Davis Bridge 1213, 140 ft. steel thru truss superstructure, with two 50 ft. I-beam approach spans, Project 3454, Tucker Co.—Ceredo Bridge 1212, 170 ft. steel thru truss, with three 40 ft. I-beam approach spans on concrete substructure, Project 186-A, Wayne Co. G. E. White, secy.

Wisconsin—Jan. 8, by State Hy. and Marinette Co. Hy. Comns., Peshtigo, graveling 13 mi. U. S. Hy. 141, S.A.P. 3396.

CONTRACTS AWARDED

Calif., Oakland—City Council, F. Merritt, city clk., grading, curbing, sidewalks, concrete paving 500,000 sq.ft. Foothill Blvd. between Parker Ave. and Hollywood Blvd., to M. J. Bevanda, 319 Elks Bldg., Stockton, $119,638. Noted Nov. 20.

New Jersey—State Hy. Comn., Trenton, 9 in. single line rein.-con., paving 3.21 mi. Morris Co., to Jannorone Constr. Co., 225 Passaic St., Belleville, $237,136. Noted Dec. 4.

N. J., Elizabeth—Union Co., Court House, improving 1 mi. South Ave., to Weldon Constr. Co., Westfield, $51,996. Noted Dec. 11.

New York—A. Goldman, comr. Plant & Structures, Municipal Bldg., New York, wood block paving main and side spans vehicular roadway for westerly upper dock Manhattan Bridge, to Welsh Bros., 35 Purvis St., Long Island City, $28,986. Noted Dec. 11.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., granite block paving Lafayette St., to St. George Paving Co., 145 Lexington Ave., $2,933; Mulberry St. and asphalt paving West 93rd St., to Meehan Paving Co., 90 West St., $17,037 and $30,828 respectively. Grand total $50,798. Noted Dec. 11.

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., grading, granite block paving Marginal St., to Columbia Contg. Co., 401 Bway., $64,426. Noted Nov. 27.

N. Y., St. George—J. A. Lynch, pres. Richmond Boro, Boro Hall, bituminous concrete repaving Sand Lane, to J. E. Donovan Paving Co., 2205 Richmond Terrace, Port Richmond, $26,852. Noted Dec. 11.

Oregon—State Hy. Comn., Portland, grading 3.01 mi. Linn Co., to Meyers & Goulter, Burke Bldg., Seattle, Wash., $86,115—13.6 mi. Coos Co., to Saxton & Looney, Corvallis, $122,195—resurfacing, widening 19 mi. Josephine Co., to Washburn & Hall, Portland, $129,860—regrading 3.47 mi. Grant Co., to W. H. Puckett, Boise, Idaho, $51,920—surfacing 10.07 mi. Lane Co., to Kern & Kibbie, 290 East Salmon St., Portland, $133,650—portions John Day Hy., Malheur Co., to Joslin & McAllister, Realty Bldg., Spokane, Wash., $90,143. Grand total $613,883.

Constr. News page 1a

Streets and Roads (Continued)

Pa., Bellevue—See "Sports and Parks."

Texas—G. Gilchrist, state hy. engr., Austin, grading, drainage structures, concrete paving 0.844 mi. Hy. 34, State Project 859-A, Tarrant Co., 44 ft., to Dexter Constr. Co., Hangar 10, Love Field, Dallas, $74,196 est. $56,000; grading, drainage structures, concrete paving and concrete paving approaches to Bear Creek Bridge, 6.11 mi. Hy. 121, State Project 774-E, F and A, reopened, same county, to McClung Constr. Co., 1309 Fort Worth Natl. Bank Bldg., Fort Worth, $154,644 est. $150,000.

Wyoming—State Hy. Comn., Capitol Bldg., Cheyenne, grading, concrete paving 4.7 mi. Sundance-Carlile Rd., Federal Aid Project 783-C, Crook Co., to Sharrock & Purcell, Casper, $41,097—grading, crushed rock surfacing 9.5 mi. Gillette-Moorcroft Rd., Federal Aid Project 120-C, Campbell Co., to Svenson Lumber Co., Laramie, $29,708—grading, gravel surfacing, resurfacing 51.533 mi. Federal Aid Projects 198-A, 37-B, 157, 99, 182-A, and 182-B combined, Platte and Goshen Counties, to Tyler & Baker, Cheyenne, $95,228. Grand total $166,033.

EXCAVATION, DRAINAGE, IRRIGATION, LEVEES, RIVER AND HARBOR

PROPOSED WORK

Ariz., Mesa — Mesa Irrigation Dist., P. A. Isley, pres., earth dam for flood protection and irrigation purposes. $200,000.

Pa., Phila.—Dpt. P. Wks., Bureau Eng. & Surveys, Grade Div., A. Murdock, dir., rejected bids Nov. 5, concrete walls, foundations in Penna. Ave. from 26th to 27th Sts. Will readvertise.

Tex., San Angelo—S. Jones & Associates, preliminary surveys irrigating several thousand acres. Private plans.

BIDS ASKED

Calif., Carmichael—Jan. 12, by R. W. Sullivan, secy. Carmichael Irrigation Dist., 2509 I St., Sacramento, 4,300 ft. welded steel pipe.

Ind., Brownstown—Jan. 2, at office S. Carr, supt. Constr., Jackson County Court, constructing 18,400 ft. William J. Quadde, et al. Drain, Hamilton twp.

Ind., Frankfort — Bd. Comrs. Clinton Co., taking bids Prairie Creek Ditch. $50,000. N. Amos, Frankfort, engr.

Ia., Cedar Rapids—Jan. 12, by City, L. J. Storey, clk., retaining wall on east bank Cedar River, Sect. A, from 1st to 2nd Aves., incl. 5,100 cu.yd. excav., 3,500 ft. piling, 316 ft. wall 28 ft. high, $46,900; Sect. B, from 2nd to 3rd Aves., 2,600 cu.yd. excav., 3,500 ft. piling, 322½ ft. wall 26 ft. high, $39,600. F. E. Young, City Hall, engr.

Kan., Kansas City—See "Contracts Awarded."

Mo., St. Louis—Jan. 13, by Bd. P. Serv., City Hall, constructing Sect. J, River Des Peres Project, incl. open channel lateral sewers, interceptors, from point about 2,000 ft. north and west of Gravois Ave., to St. Louis-San Francisco tracks near Leamington and Wellington Courts, $914,480. W. W. Horner, city engr. Noted Dec. 11.

N. Y., Long Beach—Jan. 13, by City Council, J. J. McCabe, clk., City Hall, Park Ave., constructing, extending 5 jetties; adv. E. N.-R. Jan. 1.

O., Toledo—Jan. 8, by Bd. Comrs. Lucas Co., straightening, diverting waters of Wolf Creek, in Jerusalem Twp.

CONTRACTS AWARDED

Kan., Kansas City—Fairfax Barge Canal Industrial Organization, 132 South 13th St., Lincoln, Neb., 8,500 ft. canal, 100 ft. wide, 6 ft. channel. $300,000. Owner builds. Private plans.

Calif., Long Beach—Long Beach Port, R. C. McGlone, mgr., furnishing plant, appurtenances for constructing creosoted timber wharf and stone berm at Berths 1, 2, 3 and 12, and dredging, filling Outer Harbor, to R. R. Bishop, 5017 East Bway., $104,912; furnishing, placing 4,000 tons stone for west jetty on west bank channel entrance, to Merritt-Chapman & Scott Corp., Wilmington, at $4.15 per ton. Noted Nov. 25.

O., Lima — City, F. C. Becker, city mgr., dredging, cleaning up Ottawa River, under supervision of H. Geiser, street supt. $60,000. Work started.

Public Bond Elections

Coming Bond Elections

Waterworks Impvts.—Wichita Falls, Tex., Jan. 20, $1,000,000.
Sewage Treatment Plants—Illinois, North Shore Sanitary Dist., Waukegan, $1,200,000.
Sewers and Waterworks Extensions — Canandaigua, N. Y., Jan. 22, $50,000.

Sewer Extensions — Sayre, Okla., Dec. 31, $40,000.
Court House — Dawes County, Neb., Jan. 10, $200,000.

Bonds Voted

Power Plant—Grundy Centre, Ia., $80,000, J. W. Wiersma, Engr.
Light and Power Plant — Cushing, Okla., N. Bard, Engr., $300,000.
Senior High School—Huntsville, Tex., $150,000.
Schools—San Antonio, Tex., $975,000. Phelps & DeWees, Gunter Bldg., Engrs.

Bonds Defeated

Waterworks Ext.—Checotah, Okla., $18,000.
Bridge—Duval County, Fla., $6,500,000.
School—St. Louis Park, Minn., $150,000.
Court House—Grady County, Okla., $300,000.
Waterworks and Power Plant — Colfax, La., $65,000 (postponed).

FEDERAL GOVERNMENT

PROPOSED WORK

Calif., San Francisco — HEATING PLANT, etc.—Con. Q. M., Fort Mason, remodeling hot water heating plant at commanding general's quarters, incl. new boiler, additional radiation and piping at San Francisco Presidio; installing one 300-hp. boiler at central heating plant, Fort McDowell.

Fla., Sarasota — FEDERAL BUILDING — Treas. Dpt. at office Sup. Archt., federal building, Orange Ave. and Golf St. $175,000.

Ind., Greenfield—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, East and Grant Sts.

La., New Orleans — EARTHWORK — U. S. Eng., 48,000 cu.yd. earthwork in Bonnet Carre Spillway side levees (extension), in Mississippi River.

Mo., St. Louis—STEAM DREDGES—U. S. Eng., St. Louis, three 192 ft. steel hull 24 in. steam dredges.

Mo., St. Louis — FEDERAL BUILDING — Treas. Dpt. at office Sup. Archt., plans by Mauran, Russell & Crowell, Chemical Bldg., federal building, 12th Blvd. and Market St. Noted May 5, 1929.

N. Y., Buffalo—BREAKWATER—U. S. Eng., Buffalo, repairing 622 lin.ft. breakwater in Dunkirk Harbor.

Pa., Pittsburgh — LOCK — U. S. Eng., constructing Lock 4, Monongahela River.

Tex., San Antonio—COMPANY BARRACKS—Con. Q. M., Camp Normoyle, 3 story, rein.-con., timber, clay tile, plain found.

Wis., Milwaukee—TUG BOATS—U. S. Eng., four 65 ft. 6 in. steel diesel driven tug boats.

BIDS ASKED

Arkansas—EARTHWORK—Jan. 6, by U. S. Eng., Box 667, Vicksburg, Miss., 1,050,000 cu.yd. earthwork below Jefferson-Lincoln Co. Line, Sect. 1, and in Kimbrough New Levee, on south bank Arkansas River.

Calif., Oakland—FOUNDATIONS—Jan. 5, by Treas. Dpt. at office Sup. Archt., foundations for U. S. Post Office and Court House.

Calif., Petaluma—DREDGING—Jan. 6, by U. S. Eng., Custom House, San Francisco, 73,975 cu.yd. Petaluma Creek, Sonoma Co.

Calif., Pomona—POST OFFICE—Jan. 28, by Treas. Dpt. at office Sup. Archt., U. S. Post Office. Noted Oct. 2.

Calif., San Rafael—DREDGING—Jan. 6, by U. S. Eng., Custom House, San Francisco, 42,115 cu.yd. San Rafael Creek, Marin Co.

Calif., Suisun — DREDGING — Jan. 6, by U. S. Eng., Custom House, San Francisco, 521,240 cu.yd. Suisan Bay, Solano Co.

Conn., New Haven—DREDGING—Jan. 14, by U. S. Eng., Providence, R. I., 196,900 cu.yd. New Haven Harbor; adv. E. N.-R. Jan. 1.

D. C., Wash.—SETTINGS—Spec. 6337—Jan. 7, by Yards & Docks, Navy Dpt., air cooled settings for two 1,000 hp. water tube boilers; adv. E. N.-R. Jan. 1.

Maryland—DREDGING—Jan. 17, by U. S. Eng., 300 Custom House, Baltimore, 1,452,410 cu.yd. in Curtis Bay Section, in existing channel from Fort McHenry section to and including turning basin at inner end, and widening at inner angle between inner harbor and Ferry Bar Section, Baltimore; 297,200 cu.yd. in Wicomico River; 1,714,606 cu.yd. in Cutoff-Brewerton Angle and part Brewerton section channel leading to Baltimore; 2,749,778 cu.yd. extension to Riverview Anchorage to northeast of Fort McHenry section leading to Baltimore; 41,490 cu.yd. in Elk River; 47,120 cu.yd. in Claiborne Harbor; 10,486 cu.yd. in Choptank River at Pealiquor Shoal; 11,132 cu.yd. in Herring Bay and Rockhole Creek; adv. E. N.-R. Jan. 1.

Md., Chesapeake City—BULKHEAD—Jan. 30, by U. S. Eng., Wilmington, Del., 130 lin.ft. bulkhead on Chesapeake and Delaware Canal; adv. E. N.-R. Jan. 1.

Mass., Salem—DREDGING—Jan. 6, by U. S. Eng., Custom House, Boston, in Salem Harbor; adv. E. N.-R. Jan. 1.

Mass., Springfield—POST OFFICE—Jan. 23, **by Treas. Dpt. at office Sup. Archt., U. S. Post Office. Noted Dec. 25.**

Mississippi—EARTHWORK—Jan. 6, by U. S. Eng., Box 667, Vicksburg, 613,000 cu.yd. earthwork below Greenville Enlargement, and in Ashbrook-Tarpley Enlargement, on east bank Mississippi River.

Mo., West Plains—POST OFFICE—Jan. 26, by Treas. Dpt. at office Sup. Archt., U. S. Post Office; adv. E. N.-R. Jan. 1.

N. J., Raritan—DREDGING—Jan. 6, by U. S. Eng., 39 Whitehall St., New York, 522,960 cu.yd. in Raritan Bay and Raritan River; adv. E. N.-R. Jan. 1.

New York—DREDGING—Jan. 14, by U. S. Eng., Providence, R. I., 24,400 cu.yd. Hay (West) Harbor; adv. E. N.-R. Jan. 1.

N. Y., Fort Wadsworth (mail Staten Island) —QUARTERS—Jan. 27, at office Con. Q. M., 2 double sets of non-commissioned officers quarters at Fort Wadsworth, Staten Island; adv. E. N.-R. Jan. 1. Noted Oct. 9.

North Carolina—DREDGING—Jan. 13, by U. S. Eng., Wilmington, 3,282,947 cu.yd. sand, mud and 65,800 cu.yd. rock in Sect. 1 and 2, and 2,109,837 cu.yd. sand, mud in Sect. 3 of Cape Fear River, at and below Wilmington; 209,000 cu.yd. in Morehead City Harbor; 138,000 cu.yd. in Far Creek from Pamlico Sound, to Englehard; 11,400 cu.yd. in Silver Lake Harbor; 569,000 cu.yd. in Pamlico River; 97,000 cu.yd. in Pasquotank River and Knobbs Creek; 136,000 cu.yd. in Edenton Harbor; 89,000 cu.yd. in Albermarle Sound at mouth of Roanoke River; adv. E. N.-R. Jan. 1.

North Carolina and Virginia—DREDGING—Jan. 13, by U. S. Eng. Wilmington, N. C., 288,800 cu.yd. in Beaufort Harbor, N. C., incl. Gallants Channel; 18,400 cu.yd. in waterway connecting Core Sound and Beaufort Harbor, N. C.; 2,900 cu.yd. in Inland Waterway from Norfolk, Va., to Beaufort Inlet, N. C.; adv. E. N.-R. Jan. 1.

Pa., Warren — FOUNDATIONS — Jan. 7, by Treas. Dpt. at office Sup. Archt., foundations for U. S. Post Office; adv. E. N.-R. Jan. 1. Noted May 29.

South Carolina — DREDGING — Jan. 14, by U. S. Eng., Charleston, 88,000 cu.yd. (sand, mud and shell) and removing logs and debris in Shipyard River, Charleston Harbor; 16,588 cu.yd. (sand and clay) and removing sunken logs in Waccamaw River between Conway and Red Bluff; adv. E. N.-R. Jan. 1.

Texas—DREDGING—Jan. 12, by U. S. Eng., Galveston, dredging enlargement Texas City Harbor, Channel from Galveston Harbor to Texas City; adv. E. N.-R. Jan. 1. Noted Dec. 25.

Virginia — DREDGING — Jan. 10, by U. S. Eng., Norfolk, 970,000 cu.yd. at Dancing Point-Swann Point Shoal, 1,629,500 cu.yd. at Weyanoke Point, Windmill Point—Harrison's Bar, and City Point Shoal, 489,000 cu.yd. at Rocklanding Shoal, and 1,682,000 cu.yd. at Tribell Shoal and Goose Hill Flats, all foregoing in James River; 570,000 cu.yd. in Norfolk Harbor and Hampton Roads; 233,000 cu.yd. in Nansemond River; adv. E. N.-R. Jan. 1.

Virginia—DREDGING—Jan. 17, by U. S. Eng., 300 Custom House, Baltimore, Md., 4,073 cu.yd. at mouth Nandua Creek; 38,690 cu.yd. at mouth Occohannock Creek; 33,440 cu.yd. from waterway from Tangier Sound, to Ewell (Smith Island Mo.); adv. E. N.-R. Jan. 1.

Virginia and Maryland — DREDGING — Jan. 14, by U. S. Eng., 1068 Navy Bldg., 80,000 cu.yd. from Monroe Bay and Creek, Va., and 25,000 cu.yd. from Smith Creek, Md.; adv. E. N.-R. Jan. 1.

Va., Hampton Roads — BARRACKS — Spec. 6636—Jan. 7, by Yards & Docks, Navy Dpt., 4 barrack buildings at Naval Operating Base. Noted Aug. 7.

Tex., Randolph Field—SUB-STATION—Jan. 16, by Con. Q. M. 1 electric sub-station and gas meter house; adv. E. N.-R. Jan. 1.

Wisconsin—Jan. 7, by State Hy. and Washington Co. Hy. Comns., 513 Commerce Bldg., Milwaukee, concrete paving 0.26 mi. Slinger Grade Separation, S.T.H. 60, F.A.P. 2898.

Wyo., Green River—POST OFFICE—Jan. 29, by Treas. Dpt., at office Sup. Archt., U. S. Post Office; adv. E. N.-R. Jan. 1.

CONTRACTS AWARDED

Ala., Montgomery—HEADQUARTERS—Con. Q. M., headquarters, operations building and parachute building, Maxwell Field, to Hodgson-Jones Constr. Co., Montgomery, $58,811. Noted Nov. 20.

Calif., Long Beach—BREAKWATER—U. S. Eng., Los Angeles, repairing 3,000 ft. outer breakwater, Long Beach Harbor, to Merritt, Chapman & Scott, San Pedro, $57,440. Noted Nov. 13.

Mass., Fall River — POST OFFICE — Treas. Dpt. at office Sup. Archt., 2 story, basement, brick, granite, to E. J. Pappoli, 515 Massachusetts Ave., Cambridge, $407,000. Noted Dec. 4.

Missouri—DIKES—U. S. Eng., Postal Telegraph Bldg., Kansas City, revetment and clump dike at Sheepsnose and Berlin Bends, in Missouri River, and 6,180 ft. dikes and 4,800 ft. revetment at Sheepsnose Bend, to Massman Constr. Co., Amer. Bank Bldg., Kansas City, $461,023 and $234,434 respectively. Noted Nov. 6.

Federal Government (Continued)

Mo., Dover—DIKES—U. S. Eng., Postal Telegraph Bldg., Kansas City, 6,690 standard pile clump dikes at Berlin Bend, Missouri River, to Woods Bros. Constr. Co., 132 South 13th St., Lincoln, Neb., $163,880. Noted Nov. 20.

Mo., Weldon Spring—DIKE—U. S. Eng., St. Louis, 9,000 lin.ft. piling dikes in Missouri River, to List & Weatherly Constr. Co., 416 Railway Exch. Bldg., Kansas City, $331,704. Noted Nov. 6.

N. Y., Brooklyn—STANDPIPE SYSTEM—Yards & Docks, Navy Dpt., standpipe system for store houses, New York Naval Supply Depot, 3rd Ave. and 29th St., to Afgo Eng. Co., 142 Fulton St., $19,947.

Ore., Corvallis—POST OFFICE—Treas. Dpt., at office Sup. Archt., U. S. Post Office, to Hall-LaBahn, Inc., 844 Rush St., Chicago, Ill., limestone $102,000, sandstone $100,900. May substitute local granite. Noted Nov. 6.

Tex., Randolph Field—GARAGE—Con. Q. M., garage, to R. E. McKee, 1916 Texas St., El Paso, $56,715. Noted Nov. 13.

Tex., Randolph Field—SEWAGE DISPOSAL PLANT—Con. Q. M., sewage disposal plant, to R. E. McKee, 1918 Texas St., El Paso, $56,939. Noted Dec. 1 Daily.

RAILWAYS

PROPOSED WORK

Montana—Northern Pacific Ry. Co., B. Blum, ch. engr., Railroad Bldg., St. Paul, Minn., extending 24 mi. railroad between Woodrow and Bloomfield. $750,000.

CONTRACTS AWARDED

Colorado and Utah—Denver & Rio Grande Western R.R. Co., Equitable Bldg., Denver, Colo., A. O. Ridgway, ch. engr., S. J. Pyeatt, pres., 10,000 tons steel rails for track replacement in Colorado and Utah, to Colorado Fuel & Iron Co., Pueblo, Colo.

Indiana—Indianapolis Union R.R. Co., Union Sta., Chicago, Ill., H. E. Newcomet, pres., interlocking plant, switching equipment, for terminal at Indianapolis, to Union Switch & Signal Co., Swissville (Pittsburgh P. O.), Pa., to exceed $500,000.

Indiana—Wabash R.R. Co., Exchange Bldg., St. Louis, Mo., W. R. Bennett, ch. engr., equipment for centralized traffic control from Peru to state line, to Union Switch & Signal Co., Swissville (Pittsburgh P. O.), Pa., to exceed $100,000.

Ohio—Cincinnati Union Terminal Co., Temple Bar Bldg., Cincinnati, switching equipment and interlocking plant at Cincinnati Terminal, to Union Switch & Signal Co., Swissvale (Pittsburgh P. O.), Pa., to exceed $1,500,000.

Ohio—Erie R.R., G. S. Fanning, ch. engr., 50 Church St., New York, car retarder, switching system at yards, Marion, to Union Switch & Signal Co., Swissvale (Pittsburgh P. O.), Pa.

Texas—Fort Worth & Denver Northern Ry., subsidiary Fort Worth & Denver City Ry., subsidiary Colorado & Southern Ry., R. G. Gowdy, ch. engr., Denver, Colo., grading first 10 mi. road for new line between Childress and Pampa, to Speer Contg. Co., Alvord, $66,000. Noted Sept. 18.

SUBWAYS AND TUNNELS

PROPOSED WORK

Sask., Regina—City, R. J. Westgate, comr. subway under Canadian Pacific R.R., on Winnipeg St. $150,000.

BIDS ASKED

Ont., London—Jan. 5, by Canadian Natl. Ry., T. T. Irving, ch. engr., Toronto, 300 ft. subways, 15 ft. deep, 40 ft. wide, at Wellington and Richmond Sts.

GRADE CROSSINGS

BIDS ASKED

Tex., Dallas—Jan. 26, by Dallas Co., c/o C. E. Gross, aud., 600 ft. rein.-con. underpass, approach to Corinth St. Viaduct. $435,000. Rollins & Clinger, Dallas, dist. engrs.

Tex., Fort Worth—Jan. 9, by Texas & Pacific Ry. Co., E. C. Mitchell, ch. engr., Dallas, rein.-con., steel underpass under railway tracks, at Jennings St. $560,000.

Ont., Hamilton—Toronto, Hamilton & Buffalo Ry., R. L. Latham, ch. engr., James St., taking bids preliminary grading work for track elevation program, also 10 story depot is included in plans. Total cost $3,000,000.

CONTRACTS AWARDED

N. Y., Harbor (mail Utica) — New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, eliminating grade crossing, to Walsh Constr. Co., Herald Bldg., Syracuse.

DAMS

PROPOSED WORK

Ariz., Mesa—See "Excavation, Drainage, Irrigation, Levees, Rivers and Harbor."

PIERS AND WHARVES

PROPOSED WORK

N. Y., East Greenbush—PIER and WAREHOUSE—Sun oil Co., 1608 Walnut St., Phila., Pa., and 295 Madison Ave., New York, lets contract in January or February pier and warehouse. To exceed $200,000. Private plans.

CONTRACTS AWARDED

B. C., Kalso—WHARF—N. Desjardins, secy. Dpt. P. Wks., Parliament Bldgs., Ottawa, Ont., 800 ft. timber wharf, to L. H. Rawlings, Nelson, $38,000. Noted Nov. 13.

AIRPORTS

PROPOSED WORK

Ill., Chicago—City of Chicago, City Hall, R. W. Wolfe, com., soon takes bids rehabilitating and extending airport incl. administration building, sewer connections, concrete taxi runway, grading, fencing, cinder runways, at 63rd St. and Cicero Ave. $425,000. W. Wright, City Hall, supt.

CONTRACTS AWARDED

Ind., Indianapolis—City Council, rebuilding field, electric lighting system for municipal airport, incl. revolving and code beacons, electric wind indicator, obstacle and boundary lights, bed and apron flood lights, roof sign with 8 ft. letters, to C. L. Smith, 122 South Pennsylvania St., $22,790. Est. $30,000.

Mo., Bridgeton—Bd. P. Serv., City Hall, St. Louis, general contract 1 story, 90 x 120 ft. brick, steel, concrete hangar for U. S. Naval Reserves, St. Louis Airport, to C. H. Schroeder Building & Constr. Co., 4246 Natural Bridge St., St. Louis, $40,639; plumbing and drainage, to E. J. Fisher, 4134 Westminster St., St. Louis, $4,779; steam heating, to Franke Bros. Heating Co., 4723 Delmar St., St. Louis, $7,715; electrical work ,to H. Vierheller Electric Co. 1111 Pine St., St. Louis, $4,800. Grand total $57,933. Noted Nov. 13.

POWER AND LIGHTING

PROPOSED WORK

Ind., Liberty — City installing ornamental street lighting system. $25,000.

Ind., Warsaw—City new city street lights. $25,000.

Wash., Seattle—City Light Dpt., transmission line through Renton and over Beacon Hill from Skagit River into Seattle. $500,000.

BIDS ASKED

N. Y., Creedmoor—Jan. 14, by Dpt. Mental Hygiene, State office Bldg., Albany, electric service connections, additional power plant equipment at Brooklyn State Hospital, Creedmoor Div.; adv. E. N.-R. Jan. 1.

Okla., Tulsa—City Comrs., E. Logan, aud., Municipal Bldg., taking bids central building, electrical equipment for underground fire alarm system. $275,000. Smith & Senter, Philtower Bldg., archts.

Wash., Seattle—Bd. P. Wks., bids about Jan. 22, 740 mi. copper conductor wire for high tension power wire from Diablo power house to city, $800,000; also bids early in spring, steel towers for project, $1,700,000.

CONTRACTS AWARDED

Ind., Indianapolis—See "Airports."

Ohio—Ohio Edison Co., 47 North Main St., Akron, 90 mi. electric power transmission line from Toronto to East Akron, to Allied Engineers, Inc., 20 Pine St., New York.

SPORTS AND PARKS

PROPOSED WORK

Calif., Eureka—Eureka School Dist., swimming pool, improving school grounds. Project postponed indefinitely.

La., Baton Rouge—See "Schools."

Mass., Boston—City, Park Dpt., 33 Beacon St., construction on cages and housings for animals at Franklin Park, Dorchester. $68,720 appropriated. Engineer not selected.

Mass., Boston—City, Park Dpt., 33 Beacon St., stadium, World Memorial Park, East Boston Sect. $100,000. Engineer not selected.

Mass., South Hadley—See "Schools."

N. Y., New York—Corporation, c/o Shampan & Shampan, archts., 188 Montague St., Brooklyn, beach swimming pool, pavilion, incl. circulating filter, chlorinator, brine tank, etc., Bronxdale Ave. and Antin Pl. $500,000.

N. Y., Sunnyside—Sunnyside Outdoor Recreation Center, 501 Madison Ave., New York, bids in on lockers, recreation center, at 51st St. and Roosevelt Ave. $40,000. Award of contract indefinite. W. Haugaard, 21 West 45th St., New York, archt.

Tex., Beaumont—A. B. Sawyer, pres. Jefferson Drug Co., purchased 613 acre tract and plans fencing same, probably 6 strand barb wire, constructing earthen lake, lodge, etc. Private plans.

BIDS ASKED

Ill., Champaign—Holabird & Root, archts., 333 North Michigan Ave., Chicago, taking bids 1 story, basement, 196 x 209 ft., brick, steel trusses, stone skating rink, plain found., 1,300 seating capacity, 5th St., for University of Illinois. $200,000. Noted Nov. 13.

CONTRACTS AWARDED

N. Y., New York—Park Bd., W. R. Herrick, pres. Park Dpt., Arsenal Bldg., Central Park, sewer in Manhattan Sq., to A. Cianciulli, 400 East Fordham Rd., $36,560; repairing parks and parkways, to C. D. Beckwith, Inc., Seneca Ave. and Edgewater Rd., $7,287. Noted Dec. 11.

Pa., Bellevue—Grading 25,000 cu.yd. in connection with recreation park, incl. baseball field, bleachers, tennis courts, swimming pool on Ohio River Blvd. and Kendall Ave. near Jackson Run Bridge, to Harrison Constr. Co., 21st and Sidney Sts., Pittsburgh, $10,600. Total $50,000. P. H. Martin, Fitzsimmons Bldg., Pittsburgh, engr.

HEATING AND VENTILATING

BIDS ASKED

N. Y., Dongan Hills (mail Staten Island)—Jan. 7, by W. C. Martin, archt. and supt. school Buildings, Flatbush Ave. extension and Concord St., Brooklyn, heating, ventilating, plumbing, drainage, electrical work and lighting fixtures for additions to P. S. 11, Jefferson St. between Garretson and Cromwell Aves., for Bd. Educ., 500 Park Ave., New York.

CONTRACTS AWARDED

Mass., Hyde Park — City of Boston, Dpt. School Buildings, heating and ventilating in school, Henry Drew Dist., to R. B. Crocker Co., 107 Mass. Ave., Boston, est. $25,000; plumbing, to W. N. McKenna Co., 79 Chestnut St., Boston, and electrical work, to J. & J. Electric & Machine Co., 8 Leverett St., Boston, est. $25,000. Noted Dec. 11, under "Schools."

UNCLASSIFIED

PROPOSED WORK

Colorado — GAS PIPE LINE — Colorado Natural Gas Co., c/o A. K. Lee, Hugoton, Kan., or Lamar, Colo., bids in March 212 mi. gas pipe line from Lamar to Colorado Springs and Canon City. $3,000,000.

Mass., Malden (br. Boston)—COMFORT STATION—City, Park Comn., revised plans by C. F. Springall, 50 Park St., concrete comfort station, Huntings Field, Salem St. Noted Sept. 18.

Mass., Middleboro — POLICE BARRACKS — Commonwealth of Massachusetts, Dpt. Pub. Safety, police barracks. $50,000 or more. Engineer not selected.

North and South Carolina — EMPLOYEES BUILDING — Kendall Mills Co., Spartanburg, S. C., soon lets contract employees housing project at Paw Creek, N. C., and Newberry, S. C. To exceed $150,000. Private plans.

Canada—GAS PIPE LINE—Tri Cities Utilities Ltd., Saskatoon, Sask., preliminary plans by Ford, Bacon & Davis, engrs., 39 Bway, New York, natural gas pipe line from Kinsella, Alta. to Regina, Sask. $20,000,000. This corrects report in Dec. 11 issue.

BIDS ASKED

Calif., Ukiah—GAS TANKS—Jan. 7, by F. L. Bosworth, city clk., two 5,000 cu.ft. riveted gas tanks, 6 ft. diam., 30 ft. long, ¼ in. shell, ¼ in. heads, equipped with 11 x 15 in. manhole in head, three 2 in. forged steel flanges, one 4½ in. dial pressure gage, designed for 90 lb. per sq.in. working pressure, built in accordance with A.S.M.E. Code for Unfired Pressure Vessels.

Pa., Phila.—STEEL RAIL, etc.—Jan. 2, by C. D. Young, genl. purch. agt. Pennsylvania R.R. Co., 15 North 32nd St., Contr. 4352, steel rail; Contr. 4353, steel girder rail.

CONTRACTS AWARDED

N. Y., New York—CELL TIERS—R. C. Patterson, comr. Dpt. Correction, Municipal Bldg., altering 8 tiers south wing at City Prison, to F. Teicher, 1679 Madison Ave., $54,950. Noted Dec. 4.

Tex., Huntsville—FISH HATCHERY—State Game, Fish & Oyster Comn., c/o A. E. Wood, chn., Austin, constructing fish hatchery, near here, to J. F. Buckner, 407 North Main St., Cleburne, $21,409. Est. $25,000. Noted Dec. 11.

Tex., Corpus Christi—JAIL EQUIPMENT—Nueces Co., c/o Judge, equipping new court house annex, to Pauly Jail Building Co., 2215 De Kalb St., St. Louis, Mo., $32,500.

MATERIALS

BIDS ASKED

CAST IRON PIPE—**Inglewood, Calif.**—O. Duelke, city clk., taking bids 5,000 ft. 4 in., 2,000 ft. 6 in., 1,000 ft. 8 in. and 1,000 ft. 10 in. Class "B" Bell and Spigot c.i. pipe.

METER BOXES, ASPHALT, OIL, etc.—**Oakland, Calif.**—Jan. 5, by J. Kimball, secy. East Bay Municipal Utility Dist., 512 16th St., 4,000 concrete meter boxes, 6,000 concrete water meter box covers, 50,000 gal. Grade E hot asphalt, 200,000 gal. gasoline, 25,000 gal. kerosene, 10,000 gal. lubricating oil, 50 tons pig lead.

CAST IRON PIPE—**St. Helena, Calif.**—Jan. 13, by E. R. Palmer, city clk., 4,000 ft. Class 150 B and S McWane Pacific c.i. pipe, fittings.

CREOSOTED PILING, etc.—**Florida**—Jan. 12, by State Road Dpt., Tallahassee, 19,579 M.F.B.M. creosoted bridge timbers and 300 lin. ft. creosoted piling in 25 ft. lengths, f.o.b. barge, Port Washington, for Project 840, Rd. 115, Walton Co.; 19,400 gal. T-C-1 prime, f.o.b. cars Jacksonville Beach, Project 876-C, Rd. 78, St. Johns Co. B. M. Duncan, hy. engr.

PORTLAND CEMENT—**Chicago, Ill.**—Jan. 8, by Bureau Eng., Dpt. P. Wks., City Hall, furnishing, delivering portland cement in bags required for use for period ending Dec. 31, 1931. R. W. Wolfe, comr.

LUMBER, PILING, CULVERT PIPE, etc.—**Washington, Ia.**—Jan. 16, at office Auditor, Washington Co., 3,000 lin.ft. 15 in., 2,000 lin.ft. 18 in. and 2,000 lin.ft. 24 in. culvert pipe, 2,500 pieces 3 x 12 in. x 14 ft., 800 pieces

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Materials (Continued)

3 x 12 in. x 16 ft., and 400 pieces 3 x 12 in. x 18 ft. common Douglas fir full sawn rough lumber, 108 pieces 20 ft., 72 pieces 25 ft. and 54 pieces 30 ft. creosoted yellow pine piling.

SEWER PIPE, etc.—**Minneapolis, Minn.**—Jan. 6, by F. S. Gram, city purch. agt., various sized vitr. clay sewer pipe for coming season. $100,000; 300 tons sewer castings; 150,000 bbl. portland cement. N. W. Elsberg, city engr.

HYDRATED LIME—**Wanaque, N. J.**—Jan. 6, by North Jersey Dist. Water Supply Comn., 24 Commerce St., Newark, 400 tons hydrated lime. $5,000 or more. E. Tyler, Newark, secy.

FUEL OIL, etc.—**New York, N. Y.**—Jan. 6, by H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., 220,000 gal. fuel oil; 1,200,000 gal. bituminous road surfacing materail; 150,000 gal. tar for patching hot application; 200,000 gal. bituminous road surfacing material; 550,000 gal. asphaltic cement; 200 tons pitch joint filler; 60,000 cu.yd. steam cinders; 14,000 cu.yd. asphalt sand; 10,000 bags portland cement; 5,000 cu.yd. ¾ in. stone; 1,600 tons inorganic dust; 10,000 cu.yd. binder stone; long leaf yellow pine lumber; spruce, cypress, whitewood, white pine; furnishing, erecting 350 malleable iron street sign frames.

CONTRACTS AWARDED

PIPE—**Santa Barbara, Calif.**—City Council, 1,560 ft. 8 in. Class B c.i. pipe, to Grinnell Co., 520 Mateo St., Los Angeles, at $1.10 per ft.

LUMBER and PILING—**Cedar Rapids, Ia.**—At office C. A. Senninger, aud. Linn Co., 194,260 ft. untreated and 73,729 ft. treated timber, 1,600 ft. red cedar and 3,850 ft. creosoted yellow pine piling, to Carter-Waters Corp., 215 Old Colony Bldg., Des Moines, $10,739; to Nebraska Bridge Supply & Lumber Co., 448 Peters Trust Bldg., $320; to Natl. Lumber & Creosoting Co., Dwight Bldg., Kansas City, Mo., $1,426. Grand total $12,485. Noted Nov. 13.

EQUIPMENT

PROPOSED WORK

TRACTORS, etc.—**Winona, Minn.**—Winona Co. purchasing 2 tractors, 1 grader in spring. A. Baeuerlen, co. aud.

BIDS ASKED

LIQUID CHLORINE—**Minneapolis, Minn.**—Jan. 10, by F. S. Gram, city purch. agt., 10 cars of liquid chlorine for filtration plant. N. W. Elsberg, city engr.

CATERPILLAR TRACTOR—**Wadena, Minn.**—Jan. 6, by E. Boss, aud. Wadena Co., 1 60-hp. caterpillar tractor.

MOTOR GENERATOR OUTFIT — **Norton, Mass.** — D. M. Runge, Norton, in market motor generator outfit, large kw. capacity, converting 110 a.c. to 75 d.c.

DUMP TRUCK—**Beverly Hills, Calif.**—Jan. 13, by City Council, 2½ ton dump truck for Street Dpt.

FOREIGN

Egypt — His Excellency, the Minister of P. Wks., Cairo, adding to height of Aswan Dam, to Topham, Jones & Railton, London, England. Total est. $10,000,000. Noted Nov. 21, 1929.

Peru, Lima — British Government, London, England, and British Consulate, Lima, awarded contract for British Legation Building, to Fred T. Ley Co., 578 Madison Ave., New York. Est. exceeds $150,000.

Buildings

RESIDENTIAL

BIDS ASKED

Md., Betterton—Jan. 12, by H. L. Reinhold, Jr., archt., 10 South 18th St., Phila., Pa., Royal Swan Hotel, 3 story, basement, 45 x 200 ft.; Shoreham Hotel, 5 and 6 story, basement, 45 x 200 ft.; two 2 story, basement, 20 x 150 ft. amusement buildings, connecting arcade, all foregoing brick, rein.-con., plain founds., for Royal Swan Hotel Corp. Noted Dec. 25.

Mass., Falmouth — W. Draper, Falmouth Heights, soon takes bids 4 story, basement, brick, steel hotel, stores, Terrace Gables, Falmouth Heights Sect. $150,000. J. Broadhurst, West Falmouth, archt. Noted May 29.

N. Y., Astoria (sta. Long Island City)—See "Contracts Awarded."

N. Y., Kew Gardens — See "Contracts Awarded."

N. Y., Long Island City — See "Contracts Awarded."

N. Y., New York—See "Contracts Awarded."

N. Y., New York—Delano & Aldrich, archts., 126 East 38th St., bids in June, general contract 3 story, 30 Park Ave., for H. Harkness Flagler, 32 Park Ave. $150,000.

N. Y., Queens Village — See "Contracts Awarded."

N. Y., Richmond Hill — See "Contracts Awarded."

N. Y., Tompkinsville (mail Staten Island)—See "Contracts Awarded."

CONTRACTS AWARDED

N. Y., Astoria (sta. Long Island City)—Kaywell Realty Co., 215 Montague St., Brooklyn, 6 story, 84 x 100 ft., 34th Ave. and 44th St., separate contracts. $200,000. L. Bailey, 295 6th Ave., archt.

N. Y., Jamaica—Laurelton Homes, 160-16 Jamaica Ave., 2 story, 226th St. and 130th Ave., separate contracts. $320,000. A. Allen, 163-18 Jamaica Ave., archt.

N. Y., Kew Gardens—Miruth Building Co., 16 Court St., Brooklyn, 6 story, 99 x 122 ft., Audley St. and 84th Ave., separate contracts. $150,000. J. Ricca, 186 Remsen St., Brooklyn, archt.

N. Y., Long Island City—C. W. C. Building Corp., 23-08 Steinway Ave., 6 story, 100 x 100 ft., 35th Ave. and 28th St., separate contracts. $175,000. C. Wuest, 32-02 30th Ave., Astoria, archt.

N. Y., Long Island City—Foster Madden Corp., 1 East 44th St., New York, 6 story, 85 x 180 ft., 43rd Ave. and 42nd St., separate contracts. $300,000. A. Farber, c/o owner, archt.

N. Y., Long Island City—Paqueen Building Corp., 26 Court St., Brooklyn, 6 story, 84 x 200 ft., 45th St. and Queens Blvd., separate contracts. $275,000. Cohn Bros., 363 Stone Ave., Brooklyn, archts.

N. Y., Long Island City—Webham Realty Co., 35-10 Bway., Astoria, 6 story, 86 x 150 ft., 29th St. and 34th Ave., separate contracts. $250,000. Private plans.

N. Y., Long Island City—Worthmore Holding Corp., 3152 East 6th St., Brooklyn, 6 story, 84 x 245 ft., 44th St. and Greenpoint Ave., separate contracts. $350,000. J. Ricca, 186 Remsen St., Brooklyn, archt.

N. Y., New York — Corporation, c/o R. Benenson, 295 Madison Ave., 6 story, 97 x 100 ft., Carpenter Ave. at 228th St., separate contracts. $175,000. Lilien & Lilien, 647 Tremont Ave., archts.

N. Y., New York — Decatur Gardins, Inc., 1910 Arthur Ave., 6 story, 98 x 100 ft., Decatur Ave. and Gun Hill Rd., separate contracts. $300,000. C. D. Clark, 441 Tremont Ave., archt.

N. Y., New York—Gladmere Realty Co., 1516 Nelson Ave., 6 story, 90 x 114 ft., Carpenter Ave. and 219th St., separate contracts. $200,000. Becker & Levy, 349 East 149th St., archts.

N. Y., New York—Marcia Constr. Co., 551 5th Ave., New York 6 story, Bronx Blvd. and 222nd St., separate contracts. $225,000. G. G. Miller, 545 5th Ave., archt.

N. Y., New York—Two Hundred Third Street Holding Corp., 1910 Arthur Ave., 6 story, 61 x 112 ft., Jerome and Morris Aves., separate contracts. $180,000. A. F. Inserro, 190 West 168th St., archt.

N. Y., Queens Village—Fressell Realty Co., 4301 45th St., 84 x 100 ft., 45th St. and 43rd Ave., separate contracts. $200,000. Shampan & Shampan, 188 Montague St., Brooklyn, archts.

N. Y., Richmond Hill—A. J. Cohen, 104-19 118th St., 82 x 90 ft., 117th St. and 103rd Ave., separate contracts. $150,000. S. Millman, 1780 Pitkin Ave., Brooklyn, archt.

N. Y., Tompkinsville (mail Staten Island)—Lancia Corp., Wards Hill, general contract 3 story, basement, 100 x 100 ft., brick, steel, Wards Hill, separate contracts. $150,000. C. B. Heweker, 11 Corson Ave., St. George, archt. M. G. Usland, 57 Bay St., St. George, assoc. archt.

Pa., Bradford—Hotel Holley, R. A. Fulton, prop., 149 Main St., 4 story, 100 x 100 ft., brick, cast stone, concrete top addition, also general remodeling, revamping, enlarging heating system, 149 Main St., to E. L. Van Sickel & Co., 103 Congress St., $112,000. Noted Dec. 18.

CLUBS

PROPOSED WORK

Calif., San Francisco — Y. W. C. A., 620 Sutter St., sketches by J. Morgan, Merchants Exch. Bldg., Class A club, Clay St. near Powell St. To exceed $150,000.

N. J., Orange—Y.M.C.A., 148 Central Pl., bids early in spring, 2 story, basement, brick, steel, Oakwood St. $150,000. H. B. Marsh, 7 East 48th St., New York, archt. Noted Oct. 23.

BIDS ASKED

N. J., Hohokus—P. J. Jossier, archt., 240 Broad Ave., Palisades Park, bids about Mar. 1, general contract 2 story, basement, 90 x 180 ft., brick, steel golf club, for Owner, c/o architect. $200,000. Noted Oct. 30.

N. C., Charlotte — Jan. 12, by Charlotte Country Club, c/o H. M. Wade, Charlotte, country club house. $150,000. Aymar Embury, 2nd, 150 East 61st St., New York, archt. Noted Dec. 4.

CONTRACTS AWARDED

Ark., Little Rock—Little Rock Boys Club, J. C. Conway, chn. Building Com., Amer. Exchange Trust Co., general contract 2 story, basement, 90 x 100 ft., concrete, brick, to W. Peterson, Donaghey Bldg., $79,000. Ncted July 31.

HOSPITALS

PROPOSED WORK

Ala., Mobile—Bishop Allen Memorial Home. E. J. Hackett, vicar genl. of Catholic Diocese of Alabama and Northern Florida, Georgian or Colonial type, brick, stone hospital. $250,000.

Ill., Bloomington—Mennonite Hospital Assn., 807 North Main St., N. O. Hoover, supt., plans by Lunden-Hooten-Rozen-Schaefer, Peoples Bank Bldg., 3 story, basement, 60 x 120 ft., steel, stone, rein.-con., plain found., Main St. $220,000.

Nev., Reno—Washoe Co. (1st unit) hospital. $85,000. Architect not selected.

N. Y., Brooklyn—Dpt. Hospitals, Municipal Bldg., New York, plans by Leroy E. Ward, 205 East 42nd St., New York, nurses home, training school at Kings County Hospital. $1,625,000.

N. Y., Brooklyn—Dpt. Hospitals, Municipal Bldg., New York, plans by C. B. Meyers, 31 Union Sq., New York, psychopathic building addition, for Kings County Hospital, 451 Clarkson St. $150,000.

N. Y., Dongan Hills—Dpt. Hospitals, Municipal Bldg., New York, plans by A. Mertin, 34 West 28th St., New York, nurse's home at Sea View Hospital. $150,000.

N. Y., Neponsit Beach (mail Far Rockaway)—Dpt. Hospitals, Municipal Bldg., New York, plans by Dodge & Morrison, 160 Pearl St., New York, nurses home, dormitory, at Neponsit Hospital, Bell Harbor. $300,000.

N. Y., New York — House of Calvary, Featherbed Lane and Macombs Rd., sketches by S. W. Murphy, 2095 Bway., 92 x 95 ft. hospital, Featherbed Lane and Macombs Rd. $275,000.

N. Y., New York—Dpt. Hospitals, Municipal Bldg., plans by R. Swartburg, 2 West 46th St., male dormitory addition, Fordham Hospital, Southern Blvd. $150,000. Noted Feb. 27.

N. Y., New York—Dpt. Hospitals, Municipal Bldg., plans by Schwartz & Gross, 347 5th Ave., contagious ward building at Riverside Hospital, North Brothers Islands. $500,000.

N. Y., New York—Dpt. Hospitals, Municipal Bldg., plans by Mitchell Bernstein, 2 Columbus Circle, children's tuberculosis camp, Bellevue Hospital, foot 26th St. $350,000.

O., Lakewood—City plans by Hadlow, Hughes, Hick & Conrad, Inc., archts. and engrs., 1301 Citizens Bldg., Cleveland, hospital. $1,000,000. Noted Feb. 28, 1929.

O., Lima — City Comn., Mayor D. Bogart, pres., et al, hospital. $600,000. Architect not selected.

Ore., Portland—Sutton & Whitney, archts., Lewis Bldg., bids in spring, general contract 5 story, basement, brick wing, for Emanual Hospital Assn., 600 Commercial St., $160,000.

Tex., Galveston—John Sealy Hospital plans by H. Giesecke, c/o A. & M. College, Bryan and associates, and takes bids about Mar. 1, 3 story, basement, brick, stone, rein.-con. nurses home, plain found. $400,000.

Que., Beauport — St. Michaels Archangel Asylum rebuilding wing. $750,000.

BIDS ASKED

Calif., San Francisco — Jan. 21, by S. J. Hester, secy. Bd. P. Wks., City Hall, steel, brick ward additions to hospital, Potrero Ave., for City and San Francisco Co. $379,000. Coffey & Rist, Phelan Bldg., archts.

Conn., Bridgeport—Jan. 7, by Bridgeport Hospital, W. H. Hersey, Grant St., 3 story, basement, brick children's and maternity unit, plain found., Grant St. $150,000. E. B. Caldwell, Jr., 886 Main St., archts. Noted Oct. 9.

Neb., Omaha — Jan. 13, by Bd. Supervs. Douglas Co., hospital, 42nd and Woolworth Sts. $750,000. J. Latenser & Sons, Peters Trust Bldg., archts.

N. J., Holmdel—Dpt. Institutions & Agencies, State Office Bldg., Trenton, bids about Jan. 15, general contract 2 story, basement, brick, steel reception and treatment hospital, New Jersey State Hospital grounds. $150,000. Former bids recalled. Noted Nov. 27.

N. J., New Brunswick—Maginnis & Walsh, archts., 100 Boylston St., Boston, Mass., bids about Jan. 15, general contract 5 story, basement, brick, steel, hospital addition, Easton Ave. for St. Peter's General Hospital, Easton Ave. $150,000. Noted Nov. 20.

CONTRACTS AWARDED

Calif., Stockton—State Dpt. P. Wks., Sacramento, general contract 2 story, part basement, 14,500 sq.ft. floor space, rein.-con. hospital, 2 story, 6,150 sq.ft. floor space, rein.-con. industrial building on State Hospital grounds, to Sorensen & Haggmark, 2652 Harrison St., San Francisco, $70,000. Noted Dec. 4.

CHURCHES

PROPOSED WORK

Calif., Oakland—Roman Catholic Archbishop of San Francisco, 1100 Franklin St., San Francisco, plans by W. E. Schirmer, 700 21st St., church, Emerson and Excelsior Sts. $150,000.

Ia., Ottumwa — Main Street Methodist Episcopal Congregation, plans by H. C. Haeuser, 445 Milwaukee St., Milwaukee, Wis., 76 x 114 ft. church, Main St.

Ind., Indianapolis—Presbyterian Church plans by A. A. Honeywell, 920 Architects & Builders Bldg., brick, steel memorial church, 11th St. and Ashland Ave. $150,000.

N. Y., New York—Metropolitan Temple, 91 7th Ave., plans by L. Jallade, 15 East 47th St., church, 7th Ave. and 13th St. $300,000. Noted Dec. 18.

N. Y., Scarsdale—Baptist Community Church new bids about March, on revised plans church, $250,000. H. Upjohn, Grand Central Terminal, New York, archt. Noted Oct. 16.

Churches (Continued)

N. J., Union — Congregation Presbyterian Church, c/o F. A. Elsasser, archt., 1000 Stuyvesant Ave., sketches altering and constructing 3 story, basement, brick, steel addition to chapel. $150,000.

O., Euclid (br. Cleveland)—Roman Catholic Diocese, E. J. Gracey, pastor, Guarantee Title Bldg., Cleveland, plans by E. T. P. Graham, 171 Newbury St., Boston, Mass., and F. S. Fish, resident archt., 6007 Euclid Ave., Cleveland, 1 story church. $200,000.

Okla., Oklahoma City—Episcopal Cathedral, 127 West 7th St., T. Cassady, bishop, sketches new church. $500,000. Architect not selected.

BIDS ASKED

N. J., Glen Ridge—Guilbert & Betelle, archts., 20 Branford Pl., Newark, bids about Mar. 1, general contract 2 story, basement, brick, steel church, Sunday school, for Glen Ridge Congregational Church, Ridgewood Ave. $150,000. Noted Nov. 27.

Tex., Alamo Heights—Catholic Church, c/o P. M. Baque, pastor, c/o St. Peters, Prince of Apostles Church, San Antonio, taking bids (1st unit), 3 story, basement (5 story in height), National Shrine of St. Anthony, to be known as New Alamo, brick, tile, stone, two 180 ft. towers, auditorium in rear, rein.-con. found., north of here. $225,000. Total $1,000,000. F. B. Gaenslen, Builders Exch. Bldg., San Antonio, archt. F. Drought, Smith-Young Tower, San Antonio, engr.

CONTRACTS AWARDED

Mass., South Byfield—South Byfield Methodist Church, J. F. Scott, rebuilding 1 story, basement, brick, stone, plain found., recently destroyed by fire, to H. E. Carter, North Hampton, N. H. Est. $150,000. Noted Nov. 20.

N. Y., New York—Cathedral of St. John the Divine, 119th St., cathedral unit, West Portal 119th St., to Jacob & Youngs, 370 Lexington Ave. Est. $1,300,000.

SCHOOLS

PROPOSED WORK

Calif., Oakland—Roman Catholic Archbishop, 1100 Franklin St., San Francisco, plans by H. A. Minton, Bank of Italy Bldg., San Francisco, group rein.-con. school buildings, incl. academic, auditorium, gymnasium, Piedmont Highlands. $300,000.

Calif., Oakland—Bd. Educ., City School Dist., have temporarily withdrawn bids to have been opened Dec. 30, Fremont High School, 3 story, basement, steel, concrete, Foothill Blvd. $400,000. Noted Dec. 11.

Ga., Savannah — Chatham Co. Bd. Educ., O. B. Strong, supt., plans by Levey & Clark, Savannah, and C. W. Bergen, assoc. archt., Savannah, Junior High School, 3 story, brick, tile, stone, rein.-con., Chatham Crescent. $225,000.

Ill., Chicago—Bd. Educ., 188 West Randolph St., E. Whithall, bus. mgr., rejected bids Dec. 16, Verdie Junior High School, 56th and Rockwell Sts. $1,600,000. P. Gerhardt, 188 West Randolph St., archt. Noted Nov. 27.

Ill., River Forest—E. Brielmajer & Sons Co., archts., 425 East Water St., Milwaukee, Wis., soon lets contract 4 story, basement, 60 x 250 ft., concrete, brick, addition to girls college, plain found., for Rosary College, Sinsinawa, Wis., Cram & Ferguson, 248 Boylston St., Boston, Mass., archts.

La., Baton Rouge — Louisiana State University, plans by Wogan & Bernard, Baton Rouge, Centre Building, 2 story, basement, 130 x 192 ft., rein.-con., brick, stucco, incl. concrete, tile swimming pool, dining room, post office, club rooms, $150,000, 3 story, basement, 280 x 432 ft., rein.-con., frame, stucco, group women's dormitory buildings, $500,000.

Mass., Boston — City, Dpt. School Buildings 12 room and kindergarden, brick, stone school, Gilbert Stuart Dist., Dorchester. To exceed $150,000. Architect not selected.

Mass., Lawrence — Holy Rosary Roman Catholic Church, M. Melanese, pastor, 35 Essex St., school. $150,000-$200,000. Architect not selected.

Mass., South Hadley—Mt. Holyoke College, M. E. Woolley, pres., soon takes bids 1 and 2 story, basement, brick, concrete, steel physical chemical laboratory, gymnasium and swimming pool, plain found. $150,000 or more. Putnam & Cox, 114 State St., Boston, archts. Noted Dec. 26, 1929

Mass., Wakefield—Town, J. L. McMahon, chn. building com., sketches by J. W. Beal Sons Co., 185 Devonshire St., Boston, 2 story and basement, brick intermediate school. $150,000. Stone-Underhill Co., 171 Harrison Ave., Boston, engrs.

N. J., Edgewater—Bd. Educ., 2 story, basement, brick, steel high school. $150,000. **Maturity about May.** Architect not selected. Noted Dec. 18.

N. J., Highland Park — Bd Educ., Junior High School, 2 story, basement, brick, steel, Mahar Tract. $150,000. Architect not selected. **Maturity probably in spring.** Noted Nov. 13.

N. J., Little Ferry — Bd. Educ., J. Cronin, pres., Boro Hall, revised sketches by Hacker & Hacker, 201 Main St., Fort Lee, general contract Washington School, 2 story, basement, brick, steel. $150,000. Noted July 21.

N. J., Springfield—Bd. Educ., Township Hall, sketches by F. A. Elsasser, 100 Stuyvesant Ave., Union, 2 story, basement, brick, steel, Springfield Ave. between Hillsdale Ave. and State Hy. 29. $150,000.

O., Cincinnati—St. Xavier University, Victory Blvd., plans by J. G. Steinkamp & Bro., Mercantile Library Bldg., 3 story, basement, school, Victory Blvd. $350,000.

Okla., Lawton—Dpt. Indian Affairs sketches Kiowa Indian School, 2 story. $180,000. Architect not selected. C. D. Campbell, supt.

Ore., Medford—City, E. H. Hendricks, supt. Schools, high school $210,000, ward school $60,000. Architect not selected.

Tex., Huntsville — Bd. Educ., Senior High School, rein.-con., brick, 24,000 sq.ft. floor space, plain found. $150,000 bonds voted for same. Address Bd. Educ.

BIDS ASKED

Calif., Santa Barbara—Bd. Educ. Santa Barbara City School Dist., taking bids 2 story, basement, rein.-con., incl. administration, gymnasium, shop. $350,000 or more. W. H. Weeks, 111 Sutter St., San Francisco, archt. Noted May 14.

Conn., New Canaan—Town, Bd. Educ., bids about Jan. 15, general contract Junior High School, 2 story, basement, rein.-con., brick, steel, plain found. $275,000. J. N. Pierson & Son, 198 Jefferson St., Perth Amboy, N. J., archts. Noted Dec. 4.

Conn., Waterbury — City, M. J. Donovan, supt., taking bids 2 story, basement, brick, steel addition to Tinker School. $150,000. J. T. Smith, 42 Bank St. Noted Oct. 2.

D. C., Wash. — Jan. 6, by District Comrs., District Bldg., 8 room addition to Greenleaf Whittier School.

D. C., Wash.—Jan. 9, by Dist. Comrs., District Bldg., 12 room addition to Bowen School. $200,000.

Ind., Bloomington—Jan. 23, at office J. W. Cravens, secy. Bd. Trustees Indiana University, union building, on campus. Granger & Bollenbacher, 333 North Michigan Ave., Chicago, Ill., archts.; adv. E. N.-R. Jan. 1.

La., Convent—Jan. 13, by St. James Parish School Bd., St. James and Lutcher High Schools, each 3 story, 117 x 151 ft., brick, frame, also Vacherie School, 2 story, 70 x 90 ft., incl. auditorium. W. R. Burk, Balter Bldg., New Orleans, archt.

Mass., Belmont—Town, W. E. Sperry, 350 Common St., taking bids 2 story, basement, brick, steel, School St. $150,000. G. E. Robinson, 80 Federal St., Boston, archts. Noted Dec. 25.

N. J., Roselle Park—Jan. 6, by Bd. Educ., Robert Gordon School, Grant Ave., general contract 2 story, basement, brick, steel high school, plain found., Grant Ave. $360,000. H. B. Brady, Inc., 333 North Broad St., Elizabeth, archt.

Pa., Pittsburgh—Jan. 14, Bd. Educ., H. W. Cramblet, secy., Administration Bldg., electrical work in Knoxville Junior High School, brick, steel, Grimes Ave. $350,000. P. S. Dowler, Century Bldg., archt. Noted Oct. 23.

Wis., New London—Jan. 29, by R. J. McMahon, clk. Bd. Educ., general contract 2 story high school. $200,000. Smith & Brandt, Appleton, archts.

CONTRACTS AWARDED

Calif., Berkeley—Bd. Regents University of California, general contract Eshelman Memorial (Students Publishing Building) 2 story, Class A rein.-con., to J. J. Grodem & Co., 1028 San Antonio Ave., Alameda, $116,995; heating, electric, plumbing, ventilating work, to Turner Co., 329 Tehama St., San Francisco, $22,035. Noted Dec. 4.

Ind., Ft. Wayne — School Comrs., general contract brick, rein.-con. school, to W. A. Sheets Constr. Co., 315 Cal-Wayne Bldg. Est. $150,000. Noted Nov. 13.

Ind., Lawrence—Bd. School Comrs., general contract 2 story, basement, rein.-con., stone consolidated school, to E. B. Ball & Son, 1131 North Tacoma St., Indianapolis. Est. $150,000. Noted Dec. 4.

N. J., Millburn — Bd. Educ., High School, general contract 2 story, basement, brick, steel high school addition, Old Short Hills Rd., to A. J. Robinson Co., 15 West 38th St., New York. Est. $650,000.

N. J., Woodbridge—Bd. Educ., Barron Ave., general contract 2 story, bsaement, brick, steel addition to School, Ross St., to J. Salaki, Fords; plumbing, to O. S. Donegan, Grove St.; heating and ventilating, to Jensen & Rodner, Fords. Est. $150,000. Noted Dec. 4.

N. Y., Geneva—Dpt. Educ., State Office Bldg., Albany, 3 story horticultural building at State Agricultural Experiment Station, to De Hamel Constr. Co., Plymouth Bldg., Cleveland, O., $145,300; heating, to Barr & Creelman, 74 Exchange St., Rochester, $10,200; sanitary work, to Hickey Bros., Olean, $16,550; electrical work, to W. Kallock, 936 Bay St., Rochester, $11,025. Grand total $183,075. Noted Nov. 6.

N. Y., New York — New York Institute for Education of Blind 999 Pelham Parkway, 2 story basement, 20 x 131 ft. school and dormitory, to Cauldwell-Wingate Co., 101 Park Ave. Est. $300,000. Contractor soon lets separate contracts. Noted Dec. 18.

N. Y., Port Chester—Bd. Educ., high school, to Rathgeb-Walsh, 20 Orchard Ave. Noted Dec. 4.

Pa., Pittsburgh — Bd. Educ., J. A. Bonner, supt. Buildings, Administration Bldg., general contract Arsenal Junior High and Elementary School, 4 story, basement, 223 x 383 ft., rein.-con., stone, incl. gymnasium, stage, auditorium, stage, swimming pool, lockers, library, science, kitchen, cafeteria, outdoor swimming pool, to Pittsburgh Eng. & Constr. Co., 511 North Homewood St., $689,446; heating and ventilating, to John Graham Plumbing & Heating Co., 137 Bausman St., $97,400; plumbing, to Moss & Blakely, 223 Beltzhoover Ave., $47,999. Grand total $834,842. Noted Dec. 4.

THEATRES

PROPOSED WORK

N. J., Hackensack—Warner Bros. Pictures, Inc., H. M. Warner, pres., 321 West 44th St., New York, 1 story, 100 x 100 ft., brick, steel, rein.-con., 220-22 Main St. Project in abeyance. Noted July 31.

Pa., Wilkes Barre—Warner Bros., 321 West 44th St., New York, bids after Jan. 15, general contract theatre. J. Eberson, 370 Lexington Ave., New York, archt.

BIDS ASKED

Tenn., Nashville—Warner Bros. Pictures, Inc., 321 West 44th St., New York, bids about Mar. 1, general contract 12 story theatre, office, Church St. and 6th Ave. $1,250,000. Marr & Holman, Stahlman Bldg., archts. Excavation contract awarded to Foster & Creighton Co., 4th and 1st Natl. Bank Bldg. Noted Dec. 25.

CONTRACTS AWARDED

Ariz., Phoenix — West Coast Theatres, Inc., Washington and Vermont Sts., Los Angeles, Calif., 8 story theatre, office building, to R. E. McKee, 1918 Texas St., El Paso, Tex., $252,000. Noted Dec. 4.

BANKS

BIDS ASKED

Mass., Medford (br. Boston)—See "Contracts Awarded."

Pa., Pittsburgh — Jan. 15, by R. T. McCartney, archt., 336 4th Ave., 1 story, stone, 300 Brownsville Rd., for St. Clair Savings & Trust Co., W. T. Garrow, 300 Brownsville Rd., secy. and treas.

CONTRACTS AWARDED

Ariz., Phoenix—Valley Bank Building, Inc., Craig Bldg., steel for 13 story, 137 x 150 ft. office, to Kansas City Structural Steel Co., 21st St. and Metropolitan Ave., Kansas City, Kan. Total est. $900,000. Noted Dec. 4.

Mass., Medford (br. Boston)—Medford Co-Operative Bank, 25 High St., 2 story, basement, brick, rein.-con., steel, concrete found., High St., separate contracts. $150,000. H. A. Goodspeed, 148 State St., Boston, archt. Noted July 3.

Pa., Pittsburgh — P. C. Dowler, archt., Century Bldg., 1 story, 52 ft. high, 44 x 111 ft., concrete, steel, stone bank, to H. Wimer, Keystone Bldg., for Peoples-Pittsburgh Trust Co., 4th and Wood Sts. Est. $150,000. Noted Oct. 23.

Wash., Spokane—Spokane & Eastern Trust Co., 601 Riverside St., Spokane, Wash., J. L. Campbell, secy., affiliated with Northwest Bancorporation, Minneapolis, Minn., general contract 8 story, basement, 60 x 100 ft., rein.-con., brick, terra cotta, granite bank, office, Howard and Riverside Sts., to Phelps-Drake Co., 711 Metropolitan Life Bldg., Minneapolis, Minn. Est. $500,000. Noted Nov. 20.

OFFICES

PROPOSED WORK

N. Y., Brooklyn—M. E. O'Donnell, 44 East 17th St., 4 story, 57 x 100 ft. office, Ocean and Church Aves. $150,000. Project in abeyance until late spring. Slee & Bryson, 16 Court St., archts. Noted July 3.

BIDS ASKED

Mich., Detroit—A. Kahn, archt., 1000 Marquette Bldg., bids about Jan. 8, 8 story, basement, (6 stories of offices and 2 stories of shops), stone, steel, concrete, brick, 2nd Blvd. and Bethune Ave., for Fisher Bros., New Center Development, Fisher Bldg. Noted Oct. 9.

STORES

PROPOSED WORK

Mass., Worcester—Owner, c/o J. Horowitz, Park Bldg., sketches by Blackall, Clapp & Whittemore & Clark, 31 West St., Boston, 3 story, basement, brick store, office, Mechanic and Main Sts. $150,000.

N. Y., Long Island City — City & Suburban Homes, 578 Madison Ave., New York, sketches by E. Flagg, 111 East 40th St., New York, 4-7 story, 150 x 190 ft. store, apartment, 48th Ave. and 44th St. $150,000.

N. Y., New York—Nelden Corp., B. Novnan, pres., 96 West 162nd St., 6 story store, apartment, 168th St. and Ogden Ave. $175,000.

O., Cleveland—May Co., S. L. Gross, treas., Euclid Ave., plans by Graham, Anderson, Probst & White, Railway Exch. Bldg., Chicago, Ill., altering and constructing 2 story, terra cotta, rein.-con. top addition to depratment store, Euclid Ave. $300,000.

Ont., Toronto—H. S. Howland & Sons Ltd., 138 Front St. W., plans by Langley & Howland, 146 King St. W., 3 or 4 story, concrete, brick, steel, stone store, warehouse. $175,000.

Ont., Toronto—Roy Art Galleries, 641 Yonge St., plans by J. Davidson, 119 Scollard St., 4 story, basement, 60 x 110 ft., brick, concrete, steel, stone, store, showroom, art galleries. $160,000.

BIDS ASKED

Mass., Norwood—Jan. 6, by J. M. Folan, 648 Washington St., 4 story, basement, brick mercantile building, incl. telephone exchange, plain found., Central and Cottage Sts. $175,000. McLaughlin & Burr, 88 Tremont St., Boston, archts. R. D. Kimball Co., 6 Beacon St., Boston, engrs. New England Telephone & Telegraph Co., Boston, lessee. Noted Dec. 18.

PUBLIC

PROPOSED WORK

Calif., San Marino—LIBRARY—City plans by M. Hunt and H. C. Chambers, California Reserve Bldg., rein.-con. addition. $160,000.

Mass., Newton—POLICE STATION—City, S. Weeks, mayor, soon takes bids 2 story, basement, brick, stone, steel, plain found., Washington St. $150,000 or more. J. H. Ritchie & Associates, 250 Stuart St., Boston, archts. Noted Oct. 23.

Mass., Watertown—TOWN HALL—Town, Bd. Selectmen, new town hall, Saltonstall Park Grounds. $205,000 appropriated. Architect not selected.

N. H., Claremont—ARMORY—State, W. A. Stone, State House, Concord, armory. $150,000 or more. Architect not selected.

N. J., Trenton — STATE HOUSE — State House Comn., addition to State Capitol. $2,000,000.

N. Y., Jamaica—CHILDREN'S COURT—City of New York, Dpt. Building & Offices, Municipal Bldg., New York, sketches 2½ story, children's court, Union Hall St. and South Rd. $200,000.

Tex., Menard—COURT HOUSE, etc.—Menard Co., c/o Judge, plans by Withers & Thompson, F. J. Holmes Bldg., Fort Worth, court house, jail. $150,000. Noted Oct. 9.

Tex., Spearman—COURT HOUSE—Hansford Co., C. W. King, judge, plans by Towns, Lightfoot & Funk, Johnson Bldg., Amarillo, court house, Square. $150,000.

BIDS ASKED

N. J., Paterson—HALL of RECORDS, etc.—Bd. Freeholders Passaic Co., Court House, bids about Mar. 1, 20 story, basement hall of records and county detention jail, Grand St. between Spring and Jackson Sts. $3,500,000. H. B. Crosby ,1st Natl. Bank Bldg., archt. Noted Nov. 20.

Tex., Cotulla—COURT HOUSE and JAIL—Jan. 12, by Comrs. La Salle Co. and H. T. Phelps, archt., Hicks Bldg., San Antonio, 4 story, basement, brick, rein.-con., marble, stone court house and jail, incl. steel cells, steel corridors, etc., 18,000 sq.ft. floor space, plain found. $150,000. Noted Nov. 13.

CONTRACTS AWARDED

Mo., Osage — REFORMATORY — Missouri State Prison, c/o F. B. Jones, dir. Penal Institutions, Missouri State Prison, 300 tons reinforcing steel and steel windows for intermediate reformatory, near here, to Carter-Waters Steel Corp., 2440 Pennway, Kansas City, to Laclede Steel Co., Arcade Bldg., St. Louis, and to William-Bayley Co., Jefferson City. Noted Aug. 21, under "Contracts Awarded."

BUILDINGS—UNCLASSIFIED

PROPOSED WORK

Calif., Los Angeles — NEWSPAPER PUBLISHING PLANT and OFFICE—Los Angeles Times, 100 North Bway., plans by G. B. Kanfmann, Union Bank Bldg., 13 story, basement, 165 x 365 ft., Class A rein.-con., 1st and Spring Sts. $3,500,000.

Calif., Los Angeles — NEWSPAPER PUBLISHING PLANT and OFFICE—Times-Mirror Publishing Co., 100 North Bway., plans by G. B. Kaufmann, Union Bank Bldg., 3 story, basement, 110 x 165 ft., rein.-con., Bway. $500,000.

BIDS ASKED

Mass., Foxboro—FARM BUILDINGS—Commonwealth of Massachusetts, Dpt. Mental Diseases, State House, Boston, bids about Jan. 5, group farm buildings, at State Hospital. $150,000. W. E. Boyd, c/o Dpt. Mental Diseases, engr.

CONTRACTS AWARDED

Calif., Culver City—FILM LABORATORY—Metro-Goldwyn-Mayer Studios, rein.-con., to Austin Co. of California, 777 East Washington St., Los Angeles. $200,000.

Buildings

FACTORIES AND MILLS

PROPOSED WORK

Conn., Bristol—FACTORY—Bristol Co., S. R. Bristol, secy., Waterbury, does not plan altering and constructing 2 story addition, Platts Mills. $50,000. This corrects report in Dec. 4 issue.

Ga., Macon — ICE PLANT—T. B. Buck, Columbus, 1 story, brick, concrete found. $60,000.

Mass., Brockton — PLANT — Brockton Gas Light Co., Inc., 54 Main St., sketches 2 story, brick addition, Grove and Union Sts. $40,000. C. H. Tenney Co., 38 Chauncy St., Boston, engrs.

N. Y., New York—REFRIGERATION PLANT—Dpt. Hospitals, Municipal Bldg., plans by Van Wart & Wein, 347 Madison Ave., refrigeration plant, Randalls Island. $40,000.

O., Galion—FACTORY—Gledhill Road Mchy. Co. factory. $50,000-$100,000.

Ont., Kitchener—FURNITURE PLANT—Art Furniture Co., West Lancaster St., rebuilding factory, recently destroyed by fire. $150,000. J. A. Woolner, pres. and genl. mgr. Wants prices on wood working machinery.

BIDS ASKED

Calif., Oakland—FACTORY—C. N. Burrell, archt., Amer. Bank Bldg., taking bids 1 story, concrete, 102nd Ave. for Hammer-Bray Co., 26th Ave. and East 12th St. $200,000.

Mich., Dearborn — STEEL PLANT — Ford Motor Co. taking bids for caisson work for foundation, concrete found. for mixer and furnace, open hearth steel plant. Giffels & Vallet, 604 Marquette Bldg., Detroit, engr.

N. Y., Long Island City—FACTORY—Colonial Dye Wks., c/o I. Fenichel, archt., 114 East 32nd St., bids about Feb. 1, general contract on revised plans cleaning and dye works. To exceed $40,000. Noted Sept. 11.

Utah, Woodside — DRY ICE PLANT — See "Contracts Awarded."

Man., Winnipeg — REFINERY — See "Contracts Awarded."

CONTRACTS AWARDED

Conn., Bridgeport — FACTORY — Lindstrom Tool & Toy Co., Silliman St., 2 story, 50 x 150 ft., brick, timber, Silliman St., to T. J. Pardy Constr. Co., 1481 Seaview Ave. $50,000.

Ga., Atlanta — PENCIL FACTORY — H. A. Varner, 7 Rivers Rd., 2 story, basement, 50 x 200 ft., brick, rein.-con., Houston St., to F. E. Varner, Standard Bldg. Est. $50,000.

Ill., Mt. Vernon—TEXTILE PLANT—Amer. Textiles Co., Mt. Vernon, Ill., and Bay City, Mich., 2 story, 84 x 100 ft., brick, concrete, to W. N. Atkinson, Mt. Vernon. Est. $40,000.

Ia., Sioux City—SERUM PLANT—Sioux City Serum Co., Stock Yards, 1 story, 44 x 80 ft., second story, 28 x 44 ft. also 1 story 22 x 40 ft., 24 x 34 ft. and 14 x 34 ft., buildings, all brick, hollow tile, steel, to Coomer & Small, 312 United Bank Bldg.; heating and plumbing, to Wm. LaVelle, 815 5th St.; millwork, to Curtiss Sash & Door Co., 201 West 4th St.; brick and hollow tile, to Sioux City Brick & Tile Co., 200 United Bank Bldg.; structural steel, to Haakinson & Beaty Co., 1st and Nebraska Sts.; elevators, to Euclid Mfg. Co., 1285 West 6th St., Cleveland, O. Est. $50,000.

Kan., Hutchinson—PACKING PLANT—McArthur Packing Co., remodeling and constructing addition, to Stamey Constr. Co., Stamey Hotel Bldg. Est. $46,000.

Mass., Charlestown—ICE CREAM PLANT—H. P. Hood Sons Co., 500 Rutherford Ave., altering 3 story, 75 x 185 ft., brick, rein.-con., 56 Roland St., to Somers & Drisco, Park Sq. Bldg., Boston. Est. $50,000.

Mass., Everett—BAUXITE PLANT—Merrimac Chemical Co., rebuilding 1 and 3 story, irregular sized, brick, steel plant unit recently destroyed by fire, Chemical Lane, to J. M. and C. J. Buckley Co., 183 Essex St., Boston. Est. $40,000-$50,000.

Mo., Springfield — FACTORY — Springfield Tablet Mfg. Co., 300 North Jefferson St., general contract 2 story, basement, 60 x 78 ft., brick, steel, concrete addition, Mill and Jefferson Sts., to M. E. Gillioz, Monett.

N. J., Garfield —ICE PLANT — Garfield Crystal Ice Co., Midland Ave., general contract 2 story, basement, 100 x 100 ft., brick, steel, to Mahony-Troast Constr. Co., 657 Main Ave. Est. $75,000. Noted Dec. 25, under "Contracts Awarded."

N. J., Paterson—DYE HOUSE—Apex Dyeing Co., 155 Sherman Ave., general contract 2 story, basement, 60 x 80 ft., brick, rein.-con. addition, plain found., Wayne Ave., to J. H. Steele & Son, 48 North 2nd St. Est. $45,000. Noted Aug. 14.

N. Y., Long Beach—ICE PLANT—Knickerbocker Ice Co., 41 East 42nd St., New York, ice manufacturing plant, to Kuhn Smith & Harris, 225 West 34th St., New York. Bids after Jan. 10, ice machines and equipment.

Tex., Temple—REFINERY—Texas & Pacific Coal & Oil Co., oil refinery plant, near here. $500,000. Private plans. Some of work will be done by own forces. Noted Oct. 9.

Utah, Woodside—DRY ICE PLANT—Carbon Dioxide & Chemical Co., F. Goodwin, vice pres., dry ice plant, day labor. $50,000. Work begun.

Man., Winnipeg — REFINERY — Radio Oil Refiners Ltd., Tulsa, Okla., oil refinery, 22 tanks, and 1,850 ft. spur tracks at St. Boniface, near here, by company forces. $250,000. D. J. Baise ch. engr.

Ont., Cornwall—FACTORY—Courtaulds Ltd., Cornwall and Toronto, factory, to Foundation Co. of Canada, Inc., 1538 Sherbrook St. W., Montreal, Que. To exceed $150,000.

GARAGES

PROPOSED WORK

N. Y., Brooklyn—Dpt. Hospitals, Municipal Bldg., New York, plans by LeRoy P. Ward, Inc., 205 East 42nd St., garage, shop and mechanical building at Kings Co. Hospital. $450,000.

N. Y., Dongan Hills (mail Staten Island)—Dpt. Hospitals, Manor Rd., plans by Sibley & Fetherston, 205 East 42nd St., New York, reconstructing garage, repair shop, at Sea View Hospital. $90,000.

N. Y., Jamaica—Hickory Homes Corp., c/o H. Dean, archt., Queens Village, sketches 1 story, 100 x 100 ft. service garage, 98th Ave. and 218th St. $40,000.

N. Y., Long Island City—D. H. Yeoman, 89-15 187th St., Hollis, plans by J. A. Boyle, 367 Fulton St., Brooklyn, service garage, 54th St. and 21st Ave. $50,000. **Maturity in February.** Noted Dec. 18.

N. Y., New York—Allerad Realty Corp., L. Silver, pres., 391 East 149th St., sketches by Siegel & Levy, 1775 Bway., 80 x 100 ft. service garage, Tremont and Leland Aves. $40,000.

N. Y., New York—D. Salitino, 1839 Sedgewick Ave., sketches by W. Hohauser, 17 West 44th St., 1 story, 75 x 165 ft. service garage, Sedgewick Ave. and 169th St. $40,000.

N. Y., New York—Sidlo Realty Co., L. Silver, pres., 391 East 149th St., sketches by Siegel & Levy, 1775 Bway., 2 story, basement, 50 x 140 ft. service garage, Webster Ave. and Mosholu Parkway. $40,000.

POWER PLANTS

PROPOSED WORK

Calif., Costa Mesa — Southern California Edison Co., 3rd and Bway Sts., Los Angeles, sketches electric sub-station, probably brick. $100,000.

Mass., Boston—Edison Electric Illuminating Co., 39 Boylston St., plans by Bigelow, Wadsworth, Hubbard & Smith, 11 Beacon St., 1 story, brick, rein.-con., steel steam heating plant addition, caisson found., Kneeland St. corner Utica St. $750,000. Whitney Eng. Co., 100 Arlington St., structural engrs.; also pipe mains through various streets connecting with plant. $250,000. Private plans.

Mass., West Medway — Edison Electric Illuminating Co., 39 Boylston St., Boston, improving and constructing additions to sub-power station. $167,000. Private plans.

N. Y., Dongan Hills (mail Staten Island)—Dpt. Hospital, Municipal Bldg., New York, plans by Sibley & Fetherston, 205 East 42nd St., New York power house, heating system at Sea View Hospital. $40,000.

BIDS ASKED

California—See "Contracts Awarded."

Mich., Baraga—Holland, Ackerman & Holland, 20 North Wacker Dr., Chicago, Ill., engrs., bids late in January, rein.-con., brick, steel power house, incl. two 1,600 hp. direct-connected hydro units, for hydro-electric plant at Sturgeon River, 7 mi. west of here; also dam, 55 ft. high, multiple arch type, 4,000 yd. concrete, for Barage County Light & Power Com.

Mich., Baraga—Holland, Ackerman & Holland, 20 North Wacker Dr., Chicago, Ill., engrs., taking bids on equipment for hydro-electric plant, for Baraga County Light & Power Com.

CONTRACTS AWARDED

California—Pacific Gas & Electric Co., 245 Market St., San Francisco, sub-station addition, incl. installation additional equipment, at St. Helena and Yountville, Napa Co., day labor.

Mass., Turners Falls—Turners Falls Power & Electric Co., G. W. Lawrence, pres., brick, steel, concrete power generating plant outside transformer and transmission equipment. $500,000. Owner builds. Private plans.

R. I., Providence—Narragansett Electric Co., Old Industrial Trust Bldg., 2 story, brick sub-power station, 146 Dyer St., to New England Power Constr. Co., 89 Broad St., Boston, Mass. Est. $40,000.

R. I., Providence—New England Power Assn., 89 Broad St., Boston, Mass., 1 story, brick, steel, concrete, sub-power station, Eddy and Franklin Sts., to New England Power Constr. Co., 89 Broad St., Boston, Mass. Est. $50,000 or more.

Wash., Seattle—Bd. P. Wks., foundations for power house at Diablo plant, to Ward Constr. Co., Tacoma, $279,847. Noted Dec. 5 Daily.

WAREHOUSES

PROPOSED WORK

Calif., Los Angeles—L. D. Machada, 1652 South Genesee St., sketches by R. Falkenroth, 611 Chamber of Commerce Bldg., 2 Class A rein.-con. warehouses, Pico St. and Highland Ave. $600,000.

N. Y., New York—Kay Moving Serv., 2464 Amsterdam Ave., sketches by G. S. Kingsley, 103 125th St., 8 story, 32 x 100 ft. storage warehouse, 2468 Amsterdam Ave. $150,000.

CONTRACTS AWARDED

Calif., Glendale—Bekins Van & Storage Co., 1355 South Figueroa St., Los Angeles, 7 story, rein.-con., to J. T. Bibb, 231 North Central Ave., Glendale, $150,000.

Mo., Springfield—Standard Oil Co., 500 North Grand Ave., 2 story, 64 x 122 ft. brick, rein.-con. warehouse, 1 story, 55 x 84 ft. garage, 56 x 110 ft. tank yard, National Blvd. and Frisco tracks, to M. E. Gillioz, Monett, $60,000.

See proposal advertising on page 221